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WITH

International Abstract of Surgery

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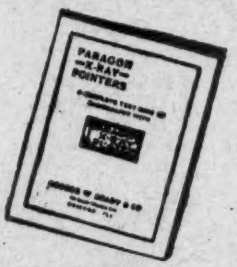

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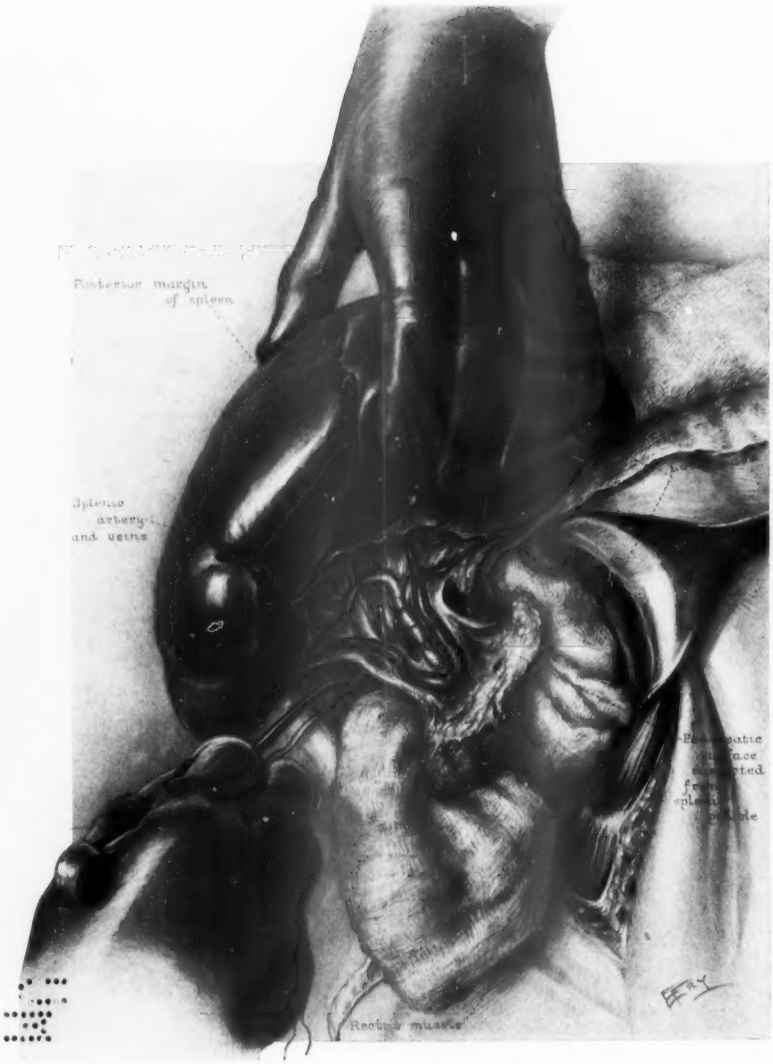

Fig. 5. Ligation of splenic pedicle. (*Donald C. Balfour.*)

SURGERY, GYNECOLOGY AND OBSTETRICS

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THE TECHNIQUE OF SPLENECTOMY

BY DONALD C. BALFOUR, M.D., F.A.C.S., ROCHESTER, MINNESOTA

THE more frequent recognition of certain chronic disorders of the blood, particularly splenic anæmia, hæmolytic jaundice and pernicious anæmia, and the therapeutic value of splenectomy in these and other diseases, have recently greatly extended the indications for splenectomy and suggested some observations on the technique of the operation. In our experience (especially in those cases in which technical difficulties are encountered), the operation has been facilitated by following a routine plan and by the precision with which the details of such a plan are carried out.

Through a left Bevan incision (Fig. 1), its length depending on the size of the spleen, the abdomen is explored. The suggestive frequency with which jaundice, attacks of epigastric pain simulating biliary colic, cirrhosis, and gall-stones, occur in many of the diseases for which splenectomy is advocated, necessitates an accurate record of the condition of the liver, gall-bladder and bile-passages. Such observations will ultimately possess specific value in the elucidation of the obscure but unquestioned intimate relationship between the spleen and the liver.

The dislocation of the spleen from its position against the diaphragm and the left kidney (Fig. 2), should be the first step in the actual removal of the organ. The separation of the diaphragmatic adhesions can usually be safely accomplished by the fingers. If it is found that the adhesions have acquired blood-vessels of sufficient size to require ligation, it is then even preferable, in most cases, to postpone such ligation (unless the vessels be reasonably accessible), until the spleen has been removed, the bleeding being temporarily controlled by a gauze pack described later. In an occasional case, however, adhesions cannot be stripped with safety, and they must be divided between long curved forceps, care being taken to engage only the adhesions in the clamps. Hartmann and others have advised that the operation be abandoned when these adhesions appear formidable. However, we have not recently found such conditions to be prohibitive to splenectomy, although in some cases absolute hæmostasis has been secured with considerable effort.

Immediately the spleen has been dislocated, a long, hot abdominal pack is efficiently arranged in the space formerly occupied by the spleen, until the entire area with which the organ has been in apposition, is under firm pressure by the gauze (Fig. 3). This accomplishes two purposes: First, and most important, the oozing surfaces are compressed and, as the bleeding is usually venous, it is controlled without subsequent ligation, if the pack (a point emphasized by W. J. Mayo), is left undisturbed until the actual operation is completed. Second, an excellent support is provided for the safe manipulation and mobilization of the organ, the division of adhesions and ligation of the main pedicle.

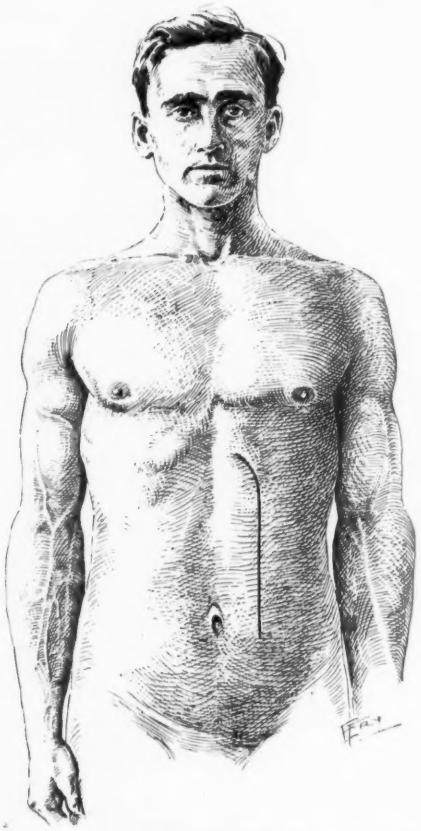


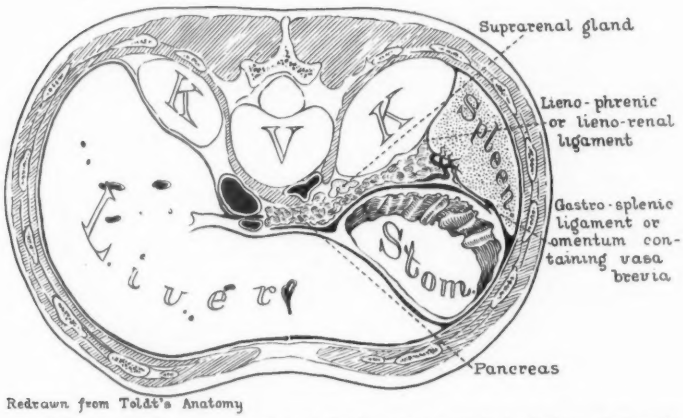
Fig. 1. Bevan incision as adapted for splenectomy.

The spleen having been elevated in this manner, its further connections are the main splenic pedicle with its peritoneal investment (the lienorenal ligament), the gastrosplenic omentum, and in splenomegaly of long standing, various adventitious adhesions. The most satisfactory isolation and treatment of the splenic pedicle is obtained by the preliminary division of the accessory adhesions, as well as the peritoneal attachments and reflections. The gastrosplenic omentum should first be divided, in sections as close as possible to the spleen, between ligatures. The only named vessels encountered are the vasa brevia, which arise from the splenic artery at variable points, pass to the greater curvature of the stomach, in this peritoneal fold, and finally anastomose with the left gastro-epiploic. In dealing with the upper edge of this gastrosplenic omentum, it must be remembered that here the fundus of the stomach is normally in very close apposition to the spleen. It is necessary, therefore, always to determine the exact relationship and protect the stomach from injury in its separation from the spleen. In an earlier experience I accidentally included in a clamp and excised a small area of the wall of the stomach, the resultant opening, however, being readily closed without post-operative complication. At the lower pole of the spleen there is an occasional fibrous attachment, derived from the phrenocolic ligament, which with the other adhesions, should be separately ligated.

The spleen may now be further mobilized by careful dissection of the peritoneal and fibrous coverings of the splenic pedicle. The localization of the tail of the pancreas is the important feature of this mobilization, and as the relationship of the organ is not constant, it is necessary to inspect it in all cases. In some instances the tail is short, lying against the renal surface of the spleen, on the posterior aspect of the pedicle, and it may be fitted so closely into the hilus of the spleen as to have acquired a concave edge. In other cases the tail is attenuated, it is in front of the splenic vessels, and in contact with the gastric surface, while often it does not extend into the operative field.

Figure 4 shows the spleen "turned turtle" and represents a frequent relationship of the pancreas to the splenic pedicle. It is quite obvious that such a pedicle would not be ligated without including a portion of the pancreas. Figure 5 (frontispiece) shows that with the reflection of the lienophrenic ligament a better exposure is obtained of the tail of the pancreas; that it can be detached from its original position by dissection and allowed to drop back from the hilus of the spleen.

Therefore, after such dissection the splenic pedicle consists, from a surgical standpoint, of the splenic artery and its veins. The artery in some instances has divided before reaching the hilus of the spleen, although it often continues as a single trunk, well into the hilus



Redrawn from Toldt's Anatomy

Fig. 2. Diagrammatic representation of the important surgical relations of the spleen.

while the veins are always in two or more branches. The latter do not bear a fixed position as regards the arterial trunks, lying in front in some instances, and behind in others. They are always distinctly larger than the artery itself, and their extreme friability must always be considered. The arrangement of the vessels of the pedicle is fan-shaped, as in Fig. 5 or 6, the breadth varying in different cases.

At this point it is possible to decide whether it is best to treat the pedicle *en masse* (Fig. 6) or to ligate it in sections (Fig. 5, frontispiece). The latter method is to be preferred and the dissection of the pedicle is usually most advantageously carried out on its posterior aspect, with the spleen tracted toward the midline. The extent to which the spleen can be lifted out of the abdomen by careful traction is surprising, if following the division of the

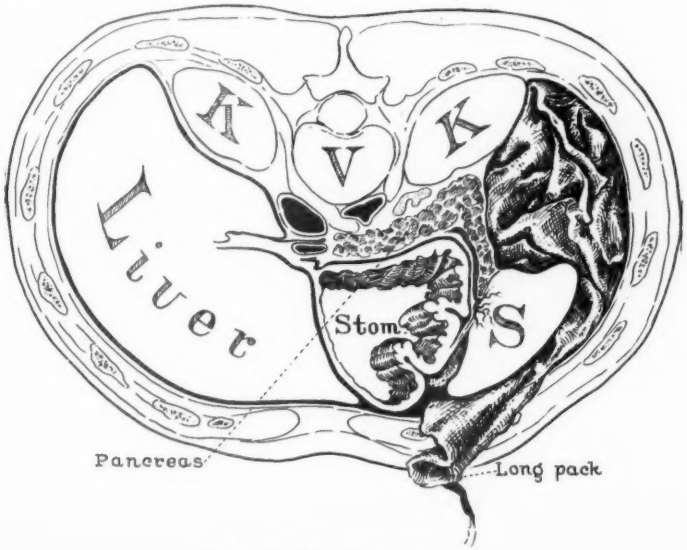


Fig. 3. Position of the gauze pack.

Fig. 4. Posterior surface of spleen exposed, showing tail of pancreas which lies in the splenic pedicle, posterior to vessels. The pancreas should be dissected from its position before clamps or ligatures are applied.

peritoneal and fibrous investments of the pedicle, certain of the lateral venous trunks, are separately isolated and divided between ligatures (Fig. 5, frontispiece). It should again be emphasized that caution must be exercised in the degree of traction to which the pedicle is subjected and in the dissection of these veins. It is chiefly because of the normal tortuosity of the splenic artery that this elongation of the pedicle is possible, and thus facilitates its secure ligation. We have recognized the advisability of first securing, where it is possible, the arterial supply, so that the spleen may partially empty itself of its contained blood through the unclamped veins before these are ligated.

If, on account of the arrangement of the veins and arterial branches, ligation in sections is not advisable, ligation *en masse* by the two-clamp method, will prove a satisfactory and safe method. Two curved clamps are arranged on the pedicle with a third clamp on the splenic side to control "back bleeding," and the spleen is removed. A double strand of No. 2 plain catgut is tied with moderate tension in the crushed line of the inner clamp, as a partial control, and a second strand is transfixed below the distal forceps as the actual control.

Having made certain, by either of these methods, that the pedicle is securely ligated, the large hæmostatic pack is removed, the newly exposed surfaces inspected, any oozing points being separately secured by fine catgut on a needle, and absolute hæmostasis assured.

The disease or condition for which splenectomy is done governs largely the technical difficulties and risk of the operation. I have found, for example, that in pernicious anæmia, the removal of the spleen can be accomplished with comparative ease and safety. Although

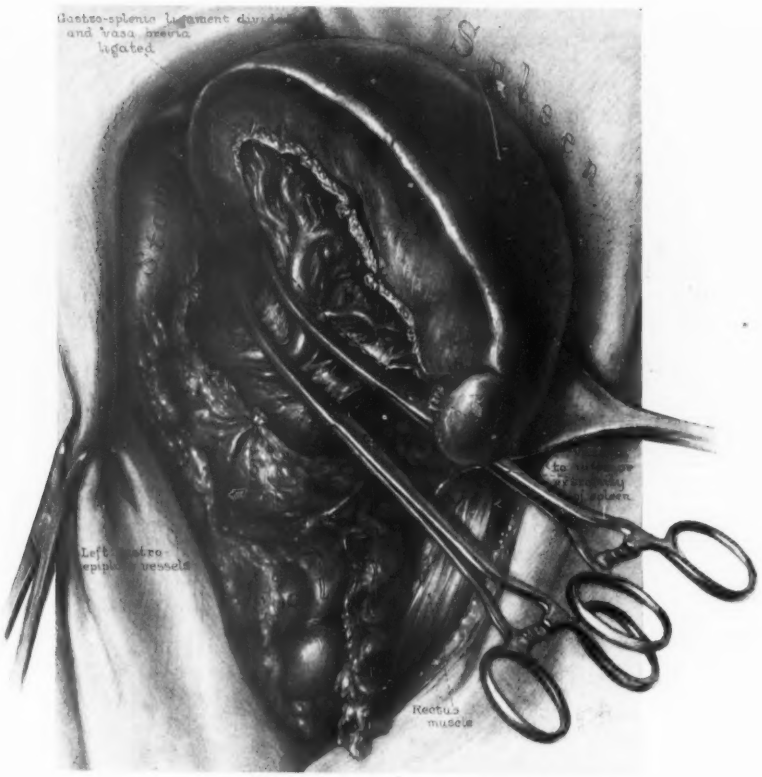


Fig. 6. Peritoneal attachments separated, mobilizing spleen and permitting application of clamps. Pedicle to be divided at dotted line.

enlargement of the organ has been present in those cases in which we have advocated surgical treatment, adhesions are few and usually insignificant. The pedicle is, as a rule, small, and in a relatively small percentage is its treatment complicated by the relationship of the pancreas. Furthermore, the risk of the operation in this disease can be minimized by intelligent pre-operative treatment and observation, as well as by the careful selection of the cases. There must be a rational basis upon which splenectomy in pernicious anæmia is advocated, as well as strict recognition of the limits of operative safety. Splenectomy is definitely contra-indicated during an acute crisis, or in a period when the patient shows a steady decrease in hæmoglobin and red blood-cells or when mental torpor, cord changes, and œdema mark the terminal stages of the disease. Repeated transfusions from a suitable donor will frequently carry the patient through most critical exacerbations of the disease and the proper interpretation of the reaction following transfusion is essential. Further, it is important that a satisfactory donor be available after operation.

In splenic anæmia, splenectomy is associated with a higher operative risk and greater technical difficulties than it is in any of the more common diseases of the spleen. In the cases I have seen, the spleen has been usually of large size, the vessels very friable, and adhesions occasionally troublesome. Patients in the late stages of the disease, are prone to develop fever, ascites, cirrhotic liver or severe

anæmia, which conditions contribute to the seriousness of the operation. The only instance in which I thought it inadvisable to attempt splenectomy, was in splenic anæmia with great ascites, atrophic cirrhosis, and aneurismal splenic vessels. The friability of the veins in this disease was especially demonstrated in a baby 22 months old, upon whom I performed splenectomy for typical splenic anæmia of the adult type.

The operation in hæmolytic jaundice is of relatively little risk and there has been no particular difficulty in the removal of the spleen, although the organ is occasionally very large. It is, however, most important to avoid splenectomy during an exacerbation of the symptoms. Of the cases I have seen of this disease, the only operative death occurred in a patient in whom I failed to realize the import of a subacute and subsiding acholuric crisis.

In those cases of cirrhosis of the liver, associated with splenomegaly, in which splenectomy is to be considered, the spleen is often firmly adherent, and this fact, together with the poor general condition of the patient, makes the operation rather hazardous. Nevertheless, in the cases we have selected for operation, there has been no operative mortality; and in two cases of my own, most striking benefit has thus far followed the removal of the spleen.

In the rarer conditions, such as syphilitic spleen and idiopathic splenomegaly, the operation itself, is not of great risk. It has been interesting to note the result of splenectomy in two cases of splenomegaly with specific history and positive Wassermann. In both of these it had been previously possible to obtain a negative Wassermann by salvarsan, but it would become positive on discontinuing the treatment. Since splenectomy the Wassermann has remained negative.

From my own experience I have found that the features to be emphasized in the technique of splenectomy are: (1) the abdominal exploration, (2) the dislocation of the spleen, (3) the use of a hot gauze pack, (4) the protection of stomach and pancreas from injury, (5) the preliminary ligation of adhesions, and (6) the treatment of the splenic pedicle.

THE ETIOLOGY OF UTERINE PROLAPSE AND CYSTOCELE[1]

By GIBBON FITZGIBBON, M.D., F.R.C.P.I., Dublin, Ireland
Gynecologist, Royal City of Dublin Hospital

THE subject of uterine prolapse and cystocele is one upon which there has been a great deal written, and still new operations are constantly being described, involving the removal of the uterus, the distortion of parts, and even the complete obliteration of the genital tract. There is surely some method by which the structures that normally support the uterus and vagina can be restored to functional activity and at the same time leave the organs which have to be supported, intact in approximately normal positions, and possibly capable of functionating — some operation which can be adopted as the all-around basis for the surgical cure of the condition.

The majority of the cases of prolapse are met in women who have borne children. The prolapse is the result of damage caused by the passage of the fœtus through the pelvis. In this act some structure which, before labor, was capable of supporting the uterus must be rendered incapable of doing so subsequently. The probability is that it is the same structure which is damaged in all or almost all the cases.

Prolapse occurring in nulliparous women is probably due to the same defective structures, but there has not been any cause of laceration, and therefore the prolapse must be due to some congenital defect of the supporting structures. This places these cases in a different category, as the supporting structures even though not injured are incapable of supporting the uterus, and any operation is subject to the doubt as to whether the tissues can be made capable of doing what they have already proved incapable of.

That the perineum and that part of the levator ani muscles which is torn with the perineum have no part in the support of the uterus, is made evident by the fact that these structures may be extensively lacerated, and this, even when of long standing, has no evident effect upon the level of the uterus. Lacerations of these structures lead to the condition of rectocele, in which the rectum bulges forward and downward into the vulva, stretching the posterior vaginal wall in its lower half, but leaving the upper half and the posterior fornix unaffected. The condition of rectocele is completely cured by a plastic operation upon the levator ani muscles and the perineum and the restoration of the parts to their normal condition.

On the other hand, there are numerous cases of prolapse of the uterus where the cervix comes down to the vulva, or even the uterus is completely extruded, yet the perineum and levator ani are intact, showing that some other structure is responsible for their maintenance and that the levator ani muscles are not capable of replacing this support. These facts definitely prove that the structures which support the lower half of the posterior vaginal wall have no part in the support of the uterus, and therefore may be excluded in looking for the cause of prolapse of the uterus which must do damage to some structures above the level of the levator muscles.

The structure which is next met with in the pelvis above the levator muscles is the visceral or endopelvic layer of pelvic fascia, and as I believe this is the main, if not the sole, support of the uterus and bladder, I wish to give a very full description of its attachments and relations.

The pelvic fascia as shown by Cunningham (1) is a direct continuation of the abdominal fascia which is easily demonstrated as a continuous sheet lining the interior of the abdominal cavity and placed between the muscles and the peritoneum. The relative position of the pelvic fascia is identical and the visceral layer passes inward from the pelvic walls upon the upper surface of the levator ani and forms a complete fascial diaphragm to close the pelvic outlet. It springs in part from the back of the symphysis and the pubic ramus, about the level of the junction of the lower

[1] Presidential Address read before the Obstetric Section of the Royal Academy of Medicine in Ireland, November 19, 1915.

and middle thirds of the symphysis. From here it runs under the bladder and forms the true anterior ligaments of the bladder. It surrounds the urethra and is intimately connected with the base of the bladder, upward along the walls of which it sends numerous fibers as well as others downward along the urethra. The fascia passing under the base of the bladder is closely connected with the anterior wall of the vagina and is continued backward to be attached to the supravaginal cervix where it helps to form the anterior vaginal fornix. This part of the fascia is very definite and usually described as the "anterior true ligament of the bladder." It binds the bladder and urethra firmly to the posterior wall of the symphysis.

The next part of the pelvic fascia springs from the pubic ramus and the white line, first at the level of the top of the obturator foramen, and from the inner surface of the ischial spine; it runs inward above the levator ani muscles toward the vagina, bladder, cervix, and rectum, and divides into the vesical, vesicovaginal, rectovaginal, and rectal layers. The posterior part of the fascia here surrounds the rectum, and follows its walls as the rectal layer, at the same time giving some support to the upper part of the posterior vaginal wall where that is in relation to the anterior wall of the rectum, and this part constitutes the rectovaginal layer. The anterior portion of this fascia is stronger and thicker than the rectal portion, and constitutes the vesicovaginal layer. As it runs inward toward the viscera it divides into numerous layers and becomes intermixed with loose connective tissue, which makes the demonstration of the whole fascia almost impossible close to the viscera. Nevertheless, the continuity can be shown and the different layers followed, to lose themselves upon the walls of the viscera or to join the fascia of the other side. It is connected to the sides of the bladder and continuous with the anterior fibers of the fascia which pass under the base of the bladder. It passes across the pelvis between the anterior vaginal wall and the base of the bladder and is attached to the cervix uteri and the lateral vaginal fornices, above which it passes to reach the cervix and to become continuous with the rectovaginal layer between the posterior vaginal fornix and the rectum and below the posterior cul-de-sac of peritoneum. The attachment of the fascia to the viscera is shown by Cunningham (2) in a dissection on the male, and the same relations of the fascia to the viscera exists in the female, the vagina and the cervix uteri taking the place of the prostate.

In the region of the lateral vaginal fornices and the sides of the cervix, where the uterine vessels approach the uterus, there is a very marked increase in the amount of fibrous tissue in which the uterine vessels run; this extra fibrous tissue forms a distinct fan-shaped band lying between the lateral vaginal fornix and the side of the cervix in the plane of the broad ligament. This band has been described by Mackenrodt (3) as the transverse ligament of the cervix. It is part of the pelvic fascia and plays a part in the support of the uterus and vagina with the rest of the fascia from which it should not be dissociated. Hart (4) refers to this as the loose fatless tissue 0.8 inches thick with abundant blood-vessels and lymphatics surrounding the lower portion of the uterus and upper portion of the vagina, and says it was first described by Virchow and called the "parametric tissue," and is clearly shown by Freund in sections at the level of the supravaginal portion of the cervix.

This intermediate part of the endopelvic fascia between the ligaments of the bladder and the rectal layer is usually described as if it merely formed a sheet above the levator ani muscles, and the rectovaginal and vesicovaginal layers as though they passed between the viscera just above the fibers of the muscle, whereas the fascia is at a higher level in this part than the levator muscle. In sections through the female pelvis this part of the fascia does not show up distinctly because the fascia is not in a distinct sheet and when the fibers are divided they retract in the loose tissue and do not show on the surface; consequently the fascia is omitted in the region of the vaginal fornices and cervix, and that part which can be demonstrated as a sheet by dissections just above the levator muscles is depicted as the whole of the vesicovaginal

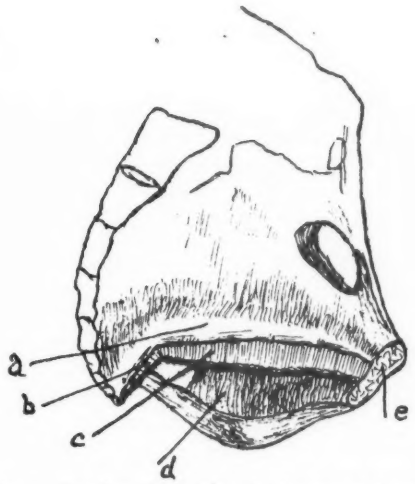


Fig. 1. Showing the origin of the visceral layer of pelvic fascia from the inner wall of the pelvis, with the levator ani muscle arising just below it. *a* Visceral layer of the pelvic fascia springing from white line, *b* coccygeus, *c* levator ani, *d* parietal layer of pelvic fascia, *e* pubic bone.

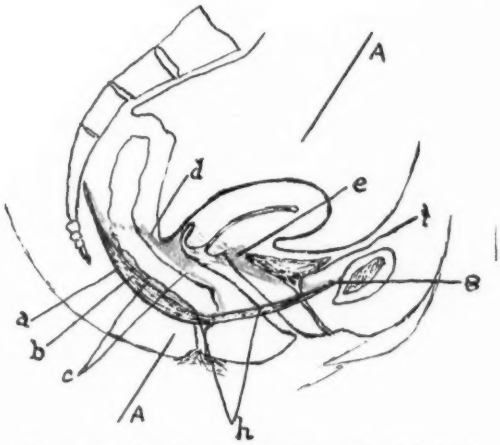


Fig. 2. Showing the division of the endopelvic fascia into the various layers in connection with the viscera, the abundance of fascia in the region of the vaginal fornices and cervix uteri and under the base of the bladder above the anterior vaginal wall. *a* Anal fascia, *b* levator ani, *c* rectal layer, *d* rectovaginal layer, *e* vesicovaginal layer, *f* vesical layer, *g* anterior ligament of bladder, *h* lower layer of endopelvic fascia, *AA* plane of section in Fig. 3.

layer. Where the fascia springs from the pelvic wall, it can be seen as a distinct sheet, but where it comes into relation with the viscera it loses the character of a sheet and divides up into various layers. The necessity for this is obvious when the dilatation which must occur during parturition is considered. If the fascia remained a single sheet where it is pierced by the cervix and the vagina, the aperture would be incapable of dilatation, whereas by means of the fascial fibers separating and running at different levels the supporting power is not diminished and the dilatation of the aperture is possible.

The description of the fascia in Cunningham's *Anatomy* together with his diagrams, makes this perfectly clear. He deals with the fascia chiefly in the male subject and refers to this description when describing the fascia in the female. He says the rectum below the rectovaginal pouch of peritoneum is in apposition with the posterior wall of the vagina, a layer of pelvic fascia, the rectovaginal alone intervening. His illustrations show this part of the fascia distinctly as well as the vesicovaginal layer, except that the prostate is shown instead of the vagina, and he says the rectoprostatic fascia is called the rectovaginal and the vesicoprostatic fascia the vesicovaginal. Cunningham (5) also describes the fascia in connection with the female pelvis as the endopelvic fascia and divides it into an upper portion attached to the upper parts of the vagina and cervix and in front of these passing between the vagina and bladder to reach the mesial plane and lose itself upon the walls of the viscera, while the lower layer is that part of the fascia which follows the levator ani muscles and is inserted into the perineal body. The relation of the viscera to the pelvic fascia is such that the bladder rests on the upper surface of the fascia in front. The vagina, owing to the backward and upward direction of its axis, passes through the plane of the fascia at an acute angle so that its anterior wall which is facing upward and forward is in relation to the under surface of the fascia at that part upon which the bladder rests. Behind this the fascia passes obliquely across the sides of the vaginal fornices and over the top of them, being attached to the cervix, and the posterior vaginal wall being longer than the anterior, is continued back so as to pass

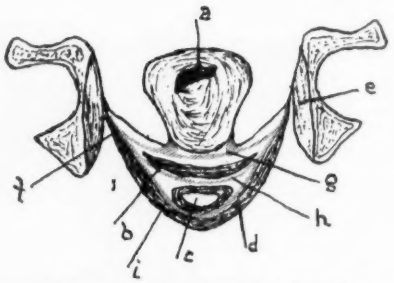


Fig. 3. Coronal section through pelvis showing the division of the visceral layer of pelvic fascia into layers in relation to the viscera. *a* Uterus, *b* vagina, *c* rectum, *d* levator ani, *e* obturator internus, *f* visceral pelvic fascia, *g* vesicovaginal layer, *h* rectovaginal layer, *i* rectal layer.

through the plane of the fascia behind the cervix. In this way the vagina is almost altogether below the plane of the fascia and has its attachment by fibers to the under surface. At the same time the fascia sends numerous fibers to all parts of the vaginal wall.

The cervix uteri definitely passes through the fascia, the vaginal portion being below, the supravaginal portion above the plane of the fascia; but owing to the oblique direction of the axis of the uterus running forward, there is a greater attachment of the fascia in front of the plane of the broad ligaments than behind, so that the vesicovaginal layer practically forms a sling across the pelvis, attached to the sides of the cervix and upon which the uterus lies when antiverted, the fundus resting upon the upper surface of the bladder.

The other ligaments of the uterus appear to be concerned only in the control of the fundus. The broad ligaments and the round ligaments can have no part in the support of the uterus. The latter with the uterus in anteversion are completely relaxed, the distance from their points of origin and insertion being considerably less than the length of the ligaments. The uterosacral ligaments are more difficult to be definite about. They are situated at a higher level than the pelvic fascia, and from the direction in which they run they would draw the cervix upward and backward. From their nature they do not seem capable of supporting the uterus, and a fact which rather bears this out is that in cases of prolapse they are found greatly elongated but not ruptured, showing that they fail and stretch when the weight of the uterus is thrown upon them. There is no evidence that they are liable to damage in labor, and therefore why should they so frequently fail in their function after labor?

Retroversion of the uterus is sometimes stated to be a predisposing cause of prolapse, but there is clinical evidence that it is not necessarily the initial stage, and from the enormous frequency of cases of retroversion in which there is no prolapse even when the rectoversion has existed for a very considerable length of time, and particularly in those cases where it occurred after parturition, it may be concluded that the position of the uterus has no influence upon the supporting structures and that retroversion in the early stages of prolapse is only a concomitant and not a predisposing cause, although it is an ultimate development in all cases.

Although I have stated that damage to the levator ani muscles has no effect upon the support of the uterus, they and the fascia have a correlated function. The levator ani form almost as complete a sheet as the fascia across the pelvis, and these two sheets together form the pelvic diaphragm. The condition is exactly analogous to the abdominal walls

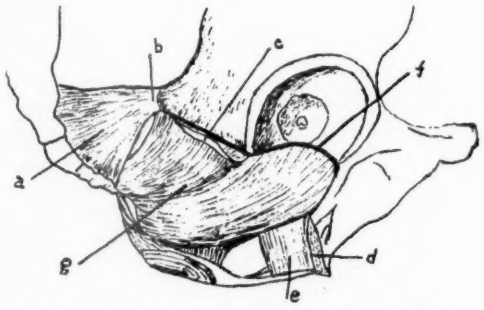


Fig. 4. Showing the levator ani muscle from the outside. It can be seen how impossible it would be for any laceration extending from the vagina to involve the posterior and higher fibers which support the vaginal fornices and uterine cervix. Lacerations can only involve the fibers which spring from the pubic bone and run backward past the vagina to surround the lower portion of the rectum and be inserted in the perineal body. *a* Coccygeus, *b* ischial spine, *c* anal fascia, *d* ischium cut away, *e* vagina, *f* acetabulum cut through, *g* levator ani.

where we have a containing sheet of fascia supported by muscles externally.

Under normal circumstances and during ordinary movements of the body, there is a certain constant pressure varying between certain limits applied to the pelvic viscera. This strain is altogether taken up by the fascia and although constantly applied has no detrimental effect upon its supporting power. Under abnormal circumstances the downward strain is increased and even though very far short of the maximum that the fascia is capable of sustaining, the muscles of the pelvic diaphragm come into action and temporarily support the fascia. Thus it can be seen that the pelvic fascia is essential to the support of the pelvic viscera and without it prolapse must occur. While the muscles are not essential but additional safeguards, and in their absence it would be quite possible for no prolapse ever to develop, on the other hand the dependence upon the muscle is shown in those cases of prolapse developing in old age in women who have never had any cause for lacerations or any tendency to prolapse during vigorous life and in whom the prolapse must be looked upon as the result of senile muscular atrophy with probable increase of strain upon the fascia and consequent loss of muscular reinforcement.

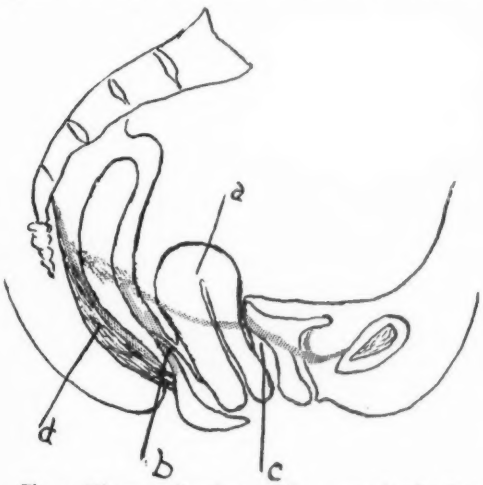


Fig. 5. Diagram of prolapse of the uterus showing how the uterus passes through the plane of the endopelvic fascia. The fascia in front of the uterus which supports the bladder being intact, the bladder retains its normal position. The vagina is inverted by being pulled down after the cervix. There is no prolapse of the vagina before the uterus. *a* Uterus, *b* posterior vaginal fornix, *c* anterior vaginal fornix, *d* levator ani.

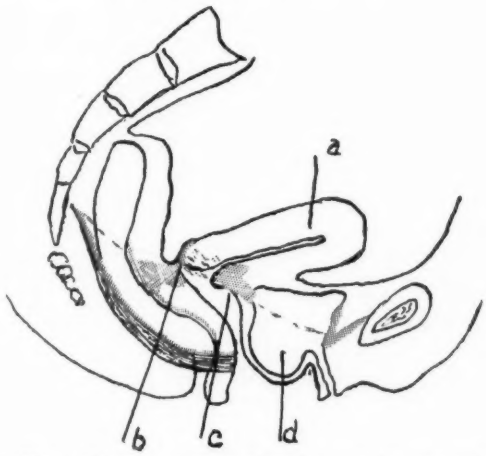


Fig. 6. Diagram of cystocele as the result of rupture of the vesicovaginal layer of endopelvic fascia. The bladder forms a hernia, stretching the anterior vaginal wall over it. The vaginal fornices and the uterus maintain their normal levels. The torn perineum allows the cystocele to develop without any resistance from the levator ani. *a* Uterus, *b* posterior fornix, *c* anterior fornix, *d* cystocele.

Lacerations occurring during parturition never could be sufficiently extensive to destroy the supporting power of the levator ani muscles. The parts of the muscles that are involved in perineal lacerations are the anterior fibers which spring from the pubic bone and run backward toward the rectum and perineal body, across the sides of the vagina; and then where there are the factors for the formation of cystocele, viz., the rupture of the fascia between the base of the bladder and the anterior vaginal wall, it can develop without anything to control it. It seems quite impossible for the posterior and higher portion of the levator ani muscles to be damaged during parturition, and therefore even in complete prolapse the muscular elements of the pelvic diaphragm, where it supports the uterus, is still intact and the defect must be looked for in the fascia.

In the majority of cases of prolapse there are found lacerations of the cervix which are not confined to the vaginal portion but ex-

tend out and involve the vaginal fornices. If these are examined it will be found that they nearly always take a curved direction when they reach the fornices so that they partially encircle the cervix. They thus involve the attachment of the fascia to the fornices and cervix in a direction transverse to the fibers of the fascia. The degree of evident laceration is no guide to the extent to which the fascia is involved; the fascia may be extensively lacerated even when the cervix is intact. The result is that the fascial sling across the pelvis is interrupted, the fascial ends being only connected to the viscera by loose connective tissue which stretches before the constant strain from above. The fascia is still there and the detached ends at their normal level, but the uterus is able to pass down between them.

Besides laceration in the region of the vaginal fornices, laceration may occur in front of the cervix where the fascia bridges across the anterior fornix and passes between the anterior vaginal wall and the bladder, in which case the bladder protrudes between the edges of the fascia and forms a cystocele. These two varieties of laceration may exist separately or together. When in the region of the lateral fornices alone, there results prolapse of the uterus with consequent inversion of the vaginal fornices, but there is no cystocele. The base of the bladder is still supported and the anterior vaginal wall relatively long. The prolapse is usually partial. When the anterior fascia alone is involved, the uterus and vaginal fornices retain their normal position, but the bladder prolapses, forming a cystocele, displacing the free edges of the fascia outward and stretching the anterior vaginal wall. When laceration occurs in the two sites, there is prolapse of the cervix and vaginal fornices as well as a protrusion of the bladder; the uterus comes down and the whole anterior vaginal wall becomes inverted.

These different conditions should be clearly differentiated. They are all the result of laceration of the fascia, but the site of laceration is different. They are analogous to abdominal hernias through scars. The recognized method of curing these hernias is to clear the edges of the fascia and unite them directly, and if this is done it does not matter how the other tissues are dealt with. Exactly the same condition prevails in the cases of prolapse of the uterus and cystocele except that the organs which become displaced have a definite position to which they should be returned, and are attached to the fascia, whereas the contents of an abdominal hernia has only to be returned to the abdomen and the sac obliterated.

I believe almost all cases of prolapse and cystocele can be dealt with on these lines. There is no difficulty in reaching the fascia at the sides of the cervix and above the lateral fornices, through an anterior colpotomy incision when the bladder is pushed up from the front of the uterus and well out to the sides so as to clear the fascia above the lateral fornices and by stripping the anterior wall away from the bladder at each side of the vertical incision.

The old operation of anterior colporrhaphy and colpoperineorrhaphy was most unsatisfactory, but occasionally resulted in cures even in pronounced cases. I believe these cures were effected upon the lines suggested above. In taking away the anterior flap of vaginal mucous membrane the incision was made sufficiently far out to reach the pelvic fascia and enough was caught in the sutures to reconstruct the pelvic sling.

In the present-day operations for prolapse, especially the Schauta-Wertheim type, there is one common feature, the high amputation of the cervix, which is done to reduce the size of the cervix and considered essential for success, although it must be admitted that numerous cases have very small atrophic uteri and proportionally small cervical portions. The amputation is done well above the vaginal level and the stump covered by the vaginal flap.

I believe it is absolutely impossible to amputate the cervix, as described, without reaching the pelvic fascia, and the curative results are due to the inclusion of the fascia with the vaginal mucous membrane in covering the cervical stump. As for the interposition part of the operation, it only relieves the cystocele and does so by using the uterus to bridge the gap in the pelvic fascia. It has

no part in supporting the cervix and is ineffective in the absence of independent means for doing this. It has the disadvantage that it necessitates future sterility, and although this only effects a small number of cases if they do not agree to it the only alternative is palliative treatment or an operation which will only give relief for a short time. As a result of failure with the Schauta-Wertheim operation there has recently been suggested a form of vaginal hysterectomy, the author (6) of which says the interposition operation is very efficient in the relief of partial prolapse with extensive cystocele. The best results being obtained in cases under forty years of age, it should not be adopted in the third and fourth degrees of prolapse. These cases are to be treated by hysterectomy, the broad ligaments are to be united in the middle line and the free edges stitched close to the urethro-vesical junction so as to compel the bladder to rest on the broad ligaments. In this operation the base of the broad ligaments when they are separated from the cervix are firmly united together and this I believe is the part of the operation which really cures the prolapse of the vaginal fornices and without which the elevation of the bladder would have no effect. It is again a reunion of the pelvic fascia which if done without removing the uterus would be really effective in curing the prolapse.

What I wish to emphasize in connection with these operations is that the one common item is plastic work in the region of the lateral fornices and cervix but that the importance of this is not recognized and credit for what is effected by this is given to other parts of the operation which are not essential, while many of the unsatisfactory results are due to non-appreciation of what is the essential part of the operation in cases of prolapse.

The lines upon which I suggest prolapse and cystocele should be treated were pointed out by Alexandroff ten or more years ago and advocated by Hastings Tweedy (7), but they have not been followed or recognized by the profession, with the result that the surgical treatment remains unsatisfactory and is chiefly upon lines which involve the interference with the function of childbirth and is therefore rendered unsuitable for an important class of cases—the younger women still in the childbearing period of life and probably desirous of having more children.

CONCLUSIONS

1. Prolapse of the uterus and cystocele are due to damage of the pelvic fascia in the region of the lateral fornices and in front of the cervix.

2. Prolapse of the uterus must be clearly differentiated from cystocele; they may exist separately or be combined.

3. Laceration of the perineum and levator ani muscles has no part in the production of prolapse. It allows an increase of cystocele when there is the primary defect.

4. Retroversion of the uterus has no tendency to produce prolapse.

5. Prolapse of the uterus and cystocele are analogous to abdominal hernias through scars, due to defective union of the fascia.

6. The cure of the condition can be effected by reuniting the fascial diaphragm across the pelvis.

7. The fascial diaphragm can be repaired without interfering with the function of the uterus or dislocating the bladder.

8. The condition can be treated in exactly the same manner before and after the menopause.

9. Atrophy of the uterus has no influence upon its support.

10. Amputation of the cervix other than the removal of an hypertrophied lacerated vaginal portion is not necessary.

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THE TRANSPANCREATIC APPROACH TO THE COMMON BILE-DUCT

TRANSPANCREATIC CHOLEDOCHOTOMY

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THE operative measures available for the removal of calculi from the gall-bladder and the upper part of the common bile-duct in a general way evince technical excellence and have well-defined indications for their employment. On the other hand, the underlying principles and the indications for the removal of gall-stones impacted in the terminal part of the common bile-duct or the papilla of Vater are not clearly understood. This seeming obscurity as to the best method appropriate for the treatment of stone impacted in the terminal part of the common bile-duct is explained partly by the fact that owing to the infrequent performance of these operations the average surgeon has but a minimal experience in this field.

The methods proposed in the standard textbooks for the removal of stones in this region represent mainly the personal experience of individual surgeons. The deductions are not based on statistical analyses of large series of cases collected from many clinics. Any operation proposed for the removal of calculi impacted in the terminal part of the common bile-duct is necessarily intricate and difficult. Technical simplicity is intrinsically impossible owing to the anatomical relations of the structures concerned, for at this point the duodenum, the pancreas, and the common bile-duct meet at a common center.

At the risk of being prolix, the writer adds another operation for the removal of calculi impacted in the terminal part of the common bile-duct. By this method, calculi can be removed from the terminal part of the common bile-duct by an incision in the head of the pancreas. The operation may be properly termed transpancreatic choledochotomy. An experience occurring to the writer furnished the incentive to this study, the object of which is to establish the practicability of the operation he employed and to bring it forward into the light of publicity. In order to describe clearly the operation, the topographical anatomy of the common bile-duct is briefly reviewed and an outline furnished of the operative methods usually recommended for the removal of calculi impacted in the terminal part of the common bile-duct.

Anatomy of the common bile-duct. Anatomists do not agree in regard to the terminology used in the description of the various segments of the common bile-duct. The division appears artificial and arbitrary. The clinical surgeon has contributed an additional classification, the terms of which express more or less a "working knowledge" of this region. A great deal of the confusion and obscurity of the terminology exist in regard to the terminal part. This is natural, as many anatomical textbooks fail to state clearly the exact relations of the common bile-duct to the pancreas.

The classification of Testut is generally used. He divides the common bile-duct into four parts; namely, the supraduodenal, the retroduodenal, the pancreatic, and the intraparietal. The use of the first two terms has been criticized by D'Este on the ground of inaccuracy. He maintains that the common bile-duct is never superior to the first part of the duodenum and that therefore the term "supraduodenal" is a misnomer. This is mentioned in passing, but the soundness of the criticism is not considered, as the main theme concerns the lower part of the duct. The common bile-duct measures 6.5 to 8 cm. in length. The supraduodenal part is almost 3 cm. long. It is intimately related to the structures contained in the foramen of Winslow and to those leaving and entering the transverse fissure of the liver; that is, the hepatic artery, the portal vein, and the lymphatic vessels. At the level of

the foramen of Winslow, the common duct occupies the free border of the gastrohepatic omentum. At this point the hepatic artery is but one to two millimeters distant from the left border of the common bile-duct. Occasionally the artery divides prematurely, remaining at first quite distant from the common bile-duct, ultimately crossing the hepatic duct obliquely. While other anomalies occur, the hepatic artery is easily avoided during operations on the common bile-duct.

The closer relations of the first part of the common bile-duct concern its inferior part. The chief relation is with the portal vein. The common bile-duct is situated on a plane anterior to the portal vein. One lymphatic node is constantly behind the foramen of Winslow, and lower down one or two nodes regularly separate the common bile-duct from the hepatic artery.

The second, or retroduodenal, part of the common bile-duct measures 20 to 25 mm. in length. In front is the duodenum, while posteriorly are the inferior vena cava and the kidney.

Testut applies the term "pancreatic" to that part of the common bile-duct which extends from the inferior border of the first part of the duodenum to the point where the duct penetrates the wall of the duodenum. It is synonymous with the infraduodenal part of other authors. It measures 20 to 25 mm. in length. Its relations have been accurately studied by Quénu, who states that it traverses a quadrilateral whose borders are formed above by the inferior border of the first part of the duodenum; below, by the superior border of the third part of the duodenum; externally, by the inner border of the second part; and internally, by the superior mesenteric vein. According to Testut, the course of this portion of the duct may be indicated by an oblique line starting from the inner one-third of the inferior border of the first part of the duodenum and ending at the middle of the internal border of the second part of the duodenum. This anatomical quadrilateral of Quénu plays an important part in the operation to be described—transpancreatic choledochotomy. It contains the pancreatic portion of the common bile-duct, and its boundaries should be definitely outlined to locate this portion of the common duct. It serves as a guide. In the quadrilateral space described by Quénu, as one approaches the duodenum the thickness of pancreatic tissue in front of the common bile-duct diminishes from above downward. At the inferior border of the first part of the duodenum it is necessary to uncover a layer 14 to 15 mm. thick in order to reach the common bile-duct. At the middle of this space (square) the pancreatic "crust" measures 10 mm. and at the border of the second part of the duodenum no more than 5 to 6 mm. Behind is the inferior vena cava, and in front is the head of the pancreas, which in turn is covered by the branches of the superior and inferior pancreaticoduodenal arteries and by the posterior parietal peritoneum.

The intraparietal part is that portion which lies within the wall of the duodenum. It penetrates the intestine at the point where the posterior surface becomes the lateral. It passes obliquely through the muscularis to lie finally in conjunction with the duct of Wirsung in the ampulla of Vater. The base of this small conical-shaped cavity is directed upward and to the left. A small transverse slit, in the form of a spur, separates one ductal opening from the other.

The diameter of the ampulla measures 6 to 7 mm. The base corresponds in size to the collective extent of the orifices of the two canals, the summit narrowing considerably, and ends in a small opening, round or elliptical in shape, which seen from the free side of the intestine appears as a tubercle. This forms the caruncula major of Santorini, or the papilla of Vater. A smaller projection exists above the caruncula major of Santorini, which indicates the duodenal termination of the accessory duct of the pancreas, the duct of Santorini. According to Corning, the arrangement of the termination just related is subject to many variations, though the above description applies in the majority of the cases. Corning states that the part described by Testut as the "pancreatic" is completely enclosed in pancreatic tissue in 75 per cent of all common bile-ducts.

The term "juxtaterminal" is applied to

the lower part of the pancreatic segment in conjunction with the intraparietal part by D'Este, who states that the expression has a surgical value, as it indicates the most frequent site of calculi in this region. He insists that these two sections should be combined and considered as an anatomical entity.

OPERATIVE METHODS EMPLOYED FOR THE REMOVAL OF IMPACTED STONES IN THE COMMON BILE-DUCT

In general, an endeavor is made to push the stone into the supraduodenal part where it may be removed through a small vertical incision. If the stone is adherent, usually to the mucous membrane, a pair of forceps may be introduced to free it. Irrigation is of doubtful value, though it may aid in the removal of small stones. Massage or manipulation is better, but one must be careful not to crush the stone as the small fragments may remain as nuclei for secondary calculi. This operation, called choledochotripsy, was first done by Courvoisier. It is indicated in soft cholesterin stones. A major objection is the possible persistence of the detritus to form nuclei of secondary calculi.

When manipulation, irrigation, and massage fail, which is seldom, a direct attack is imperative. The question now arises as to which anatomical approach is best.

The exposure of the common bile-duct where it lies behind the duodenum, by mobilization of the duodenum as suggested by Kocher, is of great utility and has many advantages. The technique employed to accomplish this operation has been formulated clearly by Kocher, who emphasizes the anatomical importance of the posterior parietal peritoneum which passes from the duodenum to the anterior face of the kidney, forming ultimately the upper layer of the transverse mesocolon. In freeing the duodenum, the duct is carried with it. It is plainly exposed, and may be directly palpated. When the duct is incised, the operation is called retroduodenal choledochotomy. It is doubtful whether direct incision is of value. In emaciated patients, the continuous loss of so much bile to the body through external drainage is objectionable. This opinion is held by Kocher and Lennander who believe that in these cases the bile should be left, if possible, to drain into the intestine. Again, injury to the duct of Wirsung is possible, as has occurred at the hands of Kocher and Kraske. Berg alters the technique by draining the hepatic duct. The incision in the common duct may then be sutured. The possibility of retroperitoneal suppuration is an additional argument against incision into the duct in this region.

The chief value of the operation of mobilization of the duodenum is that the stone may be dislodged and pushed up into the supraduodenal part where removal is easily effected. Riedel, Payr, Lorenz, and Berg state that the stone can be displaced in the majority of the cases. However, Kocher and Kehr agree that this is occasionally impossible, owing to the existence of a pericholedochitis, or to the encirclement of the common bile-duct by pancreatic tissue.

The transduodenal operation was first performed by McBurney and soon repeated by Czerny and Mayo Robson. Kocher states that this is the best operation for an impacted stone in the ampulla. He recommends mobilization as an aid in the operation. The duodenum should be opened transversely, as there is less likelihood of wounding the blood-vessels and the resulting wound is easier to suture. The papilla may be cut, though often simple tearing or expressing is sufficient. The duodenum is sutured in the usual fashion.

That another operative method exists for the removal of impacted calculi in the ampulla of Vater is not widely known. This route is through the head of the pancreas. The writer has performed this in one instance where the pathologic and anatomic conditions prevented the use of other measures. The choice of this method was entirely fortuitous, as he was unaware at the time of any previous work on the subject. Although limited to a single case, his personal experience demonstrates that it is feasible to remove calculi from the ampulla of Vater by direct attack through the head of the pancreas. The patient presented every complication tending

to make difficult any abdominal operative procedure; that is, a large, fatty, pendulous abdomen, extreme distention of the intestines, and a marked depth to the wound. The brief survival of the patient naturally eliminates from the discussion, in this particular instance, the possibility of objectionable sequelæ, as pancreatic and duodenal inflammation or fistula. It is, indeed, regrettable that the clinical test is lacking. However, the pathologic investigation obtained is of value in showing the absence of any injury to the duct of Wirsung.

To illustrate the operation, the following case is reported. The patient was admitted to the second surgical division of Fordham Hospital, in the service of Dr. W. P. Healy, through whose courtesy the writer operated on and reported this case.

Irene N.; married, age, 46; Russian, admitted November 28, 1914. One day ago she was attacked by this pain in the abdomen, vomited several times, and the abdomen became markedly distended. The patient was somewhat stuporous and apparently extremely toxic. The face was somewhat cyanotic. The tongue was coated. The heart-sounds were distant, though no murmurs were heard. Examination of the lungs was negative. The abdomen was tremendously distended. The abdominal wall was very thick with fat. There was slight rigidity and tenderness in the upper right quadrant. The abdomen was tympanitic throughout. Temperature, 102 3/5°; pulse, 136; respiration 30. Leucocytosis 23,000; 83 per cent polymorphonuclears.

The lesion was recognized as existing in the upper abdomen. Acute pancreatitis was decided upon as the most likely diagnosis, owing to the existence of the extreme distention, coupled with the peculiar cyanotic appearance of the face. These two symptoms we have noted occurring fairly often in acute pancreatitis. Immediate operation was decided upon.

Operation. Ether narcosis. The intestines were tremendously distended. A systematic exploration showed that the liver was enlarged, but no abscess was present. There was a moderate amount of brownish fluid in the right flank. The omentum presented a "chewed up" appearance, characteristic of fat necrosis. The pancreas was greatly swollen and enlarged. The gall-bladder was tense. It was opened and five stones were removed from the cystic duct. Palpation through the duodenum disclosed a calculus situated in the terminal part of the common bile-duct. All efforts to displace it up into the supraduodenal part failed. Owing to the obesity, mobilization of the duodenum was impossible. No effort to incise the posterior peritoneum could be made with success or safety. Also, the depth from the margin of the wound to the duodenum was so great and the distention so marked that I desisted from opening it. As I held the duodenum forward on my finger, I indirectly lifted up the pancreas. The idea came to reach the stone through the pancreas. A small nick was made in the pancreas and I quickly came upon the stone. I incised the duct-wall and was about to grip the stone, when the supporting hand, exercising undue pressure, caused it to slip under the duodenum to the left. However, two more stones, lying immediately above, appeared in the wound and were easily removed. These had undoubtedly been lying above the impacted stone.

A rubber drainage tube was placed in the gall-bladder according to the inversion method. A cigarette drain was put in Morrison's space, while a third reached to the site of the pancreatic incision. The incision was closed up to the point of exit of the drains.

Following the operation, the pulse increased in frequency and became exceedingly feeble, despite vigorous stimulation. Death occurred twelve hours after operation.

A partial autopsy was permitted, at which the duodenum and pancreas were removed *in toto*. The specimen was examined by Dr. Charles V. Garside, pathologist to Fordham Hospital, who reports as follows:

Description of gross specimen. The specimen consists of the head of the pancreas to which the second part of the duodenum is attached. As the duodenum was opened, the papilla appeared to be very much enlarged and the tissues around it infiltrated and necrotic.

The common bile-duct presents behind the pancreas. It is greatly distended, being 9 mm. in diameter. A probe passed through this emerges without difficulty into the duodenum. The duct of Wirsung appears to be patent.

The pancreas itself is of large size, and firm, with an occasional area of hæmorrhage. Section was taken of the papilla and of the hæmorrhagic areas and non-hæmorrhagic areas of the pancreas.

Microscopical findings. The duodenal mucosa is necrotic. The epithelium of Brunner's glands is largely desquamated. The peritoneum is richly infiltrated with polymorphonuclear leucocytes. The surrounding lymph-nodes are infiltrated with polymorphonuclear leucocytes. The common duct shows only œdema of its walls and desquamation of its lining cells. In the pancreas one finds first a few areas of cystic dilatation of ducts and acini, each the seat of a very active desquamation. A cross section of one duct presents an occluding mass of highly refractile bile-stained material; other ducts are crowded with necrotic cells, polymorphonuclear leucocytes, and bacterial colonies.

There are wide areas of pancreatic tissue in which all semblance of acinar arrangement is ob-

scured, hazy, consisting of masses of acinar cells in all stages of degeneration; in these areas there is no infiltration. In still other areas there are circumscribed foci of polymorphonuclear infiltration which have not as yet undergone liquefaction necrosis. In some of these foci bacterial colonies appear. There are a few areas of fat necrosis. The whole section presents evidence of moderate fibrosis.

Diagnosis. Suppurative pancreatitis, probably following a catarrhal inflammation, because of obstruction of ducts, the bacterial invasion coming from the duodenum via the duct. Such an occurrence is rendered probable by the finding of bile-stained material within the small ducts of the pancreas.

Conclusion. This operation demonstrated that it is feasible to remove calculi from the ampulla of Vater by direct attack through the head of the pancreas. An investigation of the literature was undertaken to discover if this particular operation had ever been performed before. It was found that the operation had been performed by Tansini, Terrier, and MacGraw, in order mentioned, chronologically, making a total of 3 cases. In all these the operation was employed as a method necessitated by the peculiar anatomic or pathologic conditions existing at the time. The three cases are detailed here for the sake of completeness. Kehr states that Keen successfully reached and extracted calculi through the head of the pancreas. A search of the literature fails to find this reference.

Stefano's case, reported by D'Este. The patient was a woman presenting the classical symptoms of stone in the common duct. An oblique incision was made, parallel to the right costal border. Very dense adhesions existed between the hepatic flexure, the great omentum, the superior angle of the duodenum, and the margin of the liver. The exploration proved difficult. After separating the adhesions at the edge of the liver, the gall-bladder was isolated and a calculus removed. Catheterization of the biliary duct was impossible. No guide or probe could be passed. The gall-bladder was removed. An effort was made to free the common bile-duct at the level of the foramen of Winslow. The reporter states that Stefano discussed with the students present in the amphitheater the advisability of retroduodenal exposure of the bile-duct, but ultimately decided that it was impossible of execution. The reason is not stated, but probably the adhesions prevented. On the same ground, most likely, he did not employ a duodenotomy. In the angle between the superior mesenteric vein, the head of the pancreas, and the duodenum, the operator felt an abnormal resistance, deeply situated. Grasping the pancreas with forceps and lifting it up, he discovered that the pancreas presented the signs of chronic inflammation with sclerotic changes. An incision was made over this mass. The common bile-duct was isolated. It was dilated and at the point of entrance into the duodenum was a swelling within the lumen. An incision was made into the common bile-duct at the site of the calculus, which incision involved slightly the outer coat of the duodenum. The inferior pole of the calculus lay in the intraparietal portion of the common bile-duct. Sutures were introduced before the removal of the stone, which was firmly adherent to the wall of the duct. Some turbid bile followed the removal of the stone. Retrograde catheterization failed to disclose the existence of additional calculi. Lembert sutures were applied to that portion of the duodenum involved in the incision. Double drainage was instituted. One tube was placed in the cystic duct; a second in the common bile-duct; and the third passed down to the field of operation. The wound was then closed. The drainage was excellent. The cystic duct fistula closed rapidly. The common bile-duct fistula took a long while to heal, though ultimately complete closure occurred. The patient made a complete recovery.

Terrier's case. Biliary lithiasis; cirrhosis; choledochotomy; death. The patient was a man 32 years of age. Vertical incision, about ten inches along margin of abdominal rectus, on right side; exposure of peritoneum. The transverse colon, which was adherent to the lower surface of the liver, was detached and turned down, but the *gall-bladder could not be found.* Imbedded in the head of the pancreas, a stone could be distinctly felt, evidently in the choledochus. Unsuccessful attempts were made to crush this calculus and to push it toward the intestine. Placing the fingers of the left hand a little behind and below the head of the pancreas, the operator cut down directly upon the calculus and opened the choledochus. The stone was then removed; it was roughened, of oval shape, 1½ inches long, and 1 inch wide. Catheterization of the choledochus served to show the permeability of the canal above and below the incision which had been applied for the withdrawal of the calculus. Suture of duct, large drainage tube under the lower surface of the liver, near the hilus. Operation lasted about one hour and a half. Death on second day following the operation. Autopsy showed that the incised ampulla of Vater was completely closed by the sutures. The drain which extended from the pancreatic incision to the abdominal wound contained a little blood-stained fluid.

MacGraw's case. The patient was a woman, 36 years old. The chief complaint was jaundice of five months' duration, associated with abdominal pain. A right rectus incision showed an enlarged liver. There were no stones in the gall-bladder, cystic or common ducts. A large hard tumor was

felt in the head of the pancreas. The pancreas was incised carefully and deliberately; the common bile-duct was exposed, opened, and the gall-stones easily expressed. The pancreas substance at the side of the incision was 1/6 inch in thickness and relatively vascular. There was only a moderate flow of bile. The stone was round and measured 2 inches in circumference. The pancreatic wound and the common bile-duct were sutured with kangaroo tendon. A rubber drainage tube was inserted and the wound was partially closed. Recovery.

In order to determine the usefulness and practicability of this transpancreatic approach to the common bile-duct, the author reproduced the operation in the anatomical laboratory of Fordham University Medical School.

In a male cadaver, the supraduodenal part of the common bile-duct was incised and two leaden shots introduced and pushed down to the end of the common duct, in order to simulate the operative findings. The quadrilateral described by Quénu was easily recognized. The second and third fingers of the left hand were placed behind the second part of the duodenum, while in front the thumb of the left hand acted as the palpating finger. The shot could be easily felt. By flexion of the second and third fingers and an upward pull, the *entire anatomic "mass" lying* upon these two fingers was lifted up and brought forward. This rendered the pancreas quite accessible. The pseudo calculi were again palpated and with the pancreas parenchyma lying over them were brought forward. A pair of blunt-pointed scissors "tore through" or dilacerated the pancreas and exposed the terminal part of the common bile-duct immediately before its junction with the duct of Wirsung. The common bile-duct was then nicked longitudinally, and the shot exposed. They were easily expressed. The common bile-duct was recognized by the dark color it presented, in contradistinction to the white pancreatic tissue. The technique proved simple, and this particular cadaver demonstrated the feasibility of removing a leaden shot from the terminal part of the common duct by incising its wall through a preliminary incision in the head of the pancreas without injuring the duct of Wirsung. Following the operation, the duodenum and pancreas and the common bile-duct were removed *in toto*. A careful dissection subsequently showed that the duct of Wirsung was patent, intact, and uninjured.

The occurrence of injury to the canal of Wirsung during pancreatic operations, causing troublesome fistula, is probably extremely exaggerated. La Courtre and Charbonnel collected sixteen cases of pancreatic lithiasis which had been subjected to operation. There were three immediate deaths following exploratory incision, and two deaths occurring within a few days. Allen's patient died at the end of the fifth day. Two pancreatic calculi were removed from a pancreatic cyst situated between the liver and the stomach. In Pearce Gould's case, death occurred on the eleventh day. A stone had been removed from the canal of Wirsung. Autopsy showed multiple calculi in the pancreas, associated with a hydatid cyst of the liver. In the remaining cases subjected to operation, which recovered, no mention whatsoever is made of the occurrence of pancreatic fistula.

In passing, it may be mentioned that Cherecelli has performed experimental suture of the duct of Wirsung. It is a feasible operation. However, from a study of the above cases of pancreatic lithiasis there is slight occasion for fear of the development of troublesome complications if the duct be accidentally divided. As to the possibility of injury to the duct of Santorini, very little is known.

The lesser duct lies, as a rule, on a plane central to the main duct. As to the result of its division, the writer is unacquainted with any clinical or experimental reports which would throw light upon the question. It is extremely probable that its division, accidental or deliberate, would be negligible.

The anatomical researches of Baldwin afford valuable information in this respect. He found that in 13.2 per cent of the cadavers (10 out of 76 specimens) the accessory duct failed to join the main duct; in 86.8 per cent of the cases, (the remaining 66 specimens) junction was effected with the main duct in the head of the gland, close to the neck. We see, therefore, that in 86.6 per cent of the

cases the accessory duct has two terminations. It seems natural to conclude that the division of its duct in any part of its course would not lead to either obstruction or leakage of the pancreatic secretion. The occurrence of hæmorrhage might be claimed as an objection to the employment of the transpancreatic route. In the cases of pancreatic calculi, this objection does not exist, for it has been shown by LaCoutre and Czerny that pancreatic stones tend to exteriorize themselves and push back the pancreatic tissue so that the covering layer becomes quite thick and relatively anæmic. It is possible that this process takes place in the case of biliary calculi. The investigations of Quénu, mentioned above, as to the relative thickness of the pancreatic tissue situated in front of the common bile-duct should be kept in mind. This pancreatic crust is so thin that it would appear that no extreme amount of pressure is needed to make it relatively anæmic. Moreover, the writer's personal operative experience did not demonstrate the occurrence of hæmorrhage, and the cases of Tansini, Terrier, and MacGraw do not lend any support to those who would object to this operation on the ground of troublesome hæmorrhage.

It should be recalled that an incision of the pancreas in this particular region has been warmly recommended by Vautrin for the treatment of chronic pancreatitis. He advocates the division of the collar of pancreatic tissue which compresses the common bile-duct. This operation has been employed by Vautrin, Martino, and Czerny. No mention is made by Vautrin of these surgeons' meeting hæmorrhage in performing this type of pancreatotomy.

These three objections, injury to the duct of Wirsung, pancreatic fistula, and the occurrence of severe hæmorrhage, seem to lose in strength when the anatomy of the pancreas and the clinical reports of pancreatic operations are carefully studied. That these objections are real, no one can doubt. That they are valid, is open to question. Nevertheless, these objections are sufficiently real and strong to prevent the selection of the transpancreatic route for impacted calculi, when the retroduodenal or transduodenal routes are available. However, if these routes are impracticable owing to complications, such as occurred in the writer's case and in the cases of Terrier, Tansini, and MacGraw, where the adhesions were extensive, the operation of transpancreatic choledochotomy has a definite field of usefulness.

The advice of a surgeon in regard to a technical procedure naturally rests ultimately upon the great familiarity of the surgeon with that particular operation. Many operations can be based on *à priori* anatomical, technical, and physiological grounds, and the real test is a definite practical experience on the living. For example, the extreme intestinal distention of acute pancreatitis may render a certain operation impossible; or, on the other hand, in a thin, wasted, and emaciated patient, with collapsed intestines, the technical difficulties are diminished.

If one were certain of the calculus being lodged in the lower portion of the pancreatic part of the common bile-duct, an incision directly backward into the pancreas might be indicated. If the calculus were partly in the intraparietal part of the common bile-duct, the stone could be reached by an oblique route through the head of the pancreas, approaching the upper part of the calculus so as to come upon it from above downward, thereby guarding against injury to the duct of Wirsung.

It may be difficult to determine whether a part of the calculus rests in the common duct or whether it lies completely within the wall of the duodenum. The danger of leakage from the intestine seems remote so long as the papilla is intact. The opening through which the stone is removed is exceedingly small.

The operation of transpancreatic choledochotomy is presented for consideration as a measure of occasional applicability and usefulness. The writer has no intention to urge or even to suggest that this operation be used to supplant the older procedures now in vogue.

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EXCISION VERSUS GASTRO-ENTEROSTOMY [1]

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SURGEONS of experience have long since recognized the value of gastro-enterostomy in the treatment of gastric and duodenal ulcer. When the indications for its performance are present and when done by competent hands the results following this operation have justified the confidence with which it has been so frequently employed. It must be admitted, however, that like many other surgical procedures which have been popularized by competent men, it has been too frequently employed when sufficient indications for such employment did not exist.

It is a well-established fact that a gastro-enterostomy made in the absence of well defined and understood pathological conditions involving the stomach or duodenum or both, will prove worse than disappointing. Yet far too many operations are being performed by surgeons who open the abdomen expecting to find an ulcer, and who, failing to find one, can think of nothing else to do than the gastro-enterostomy, which they had decided one or two days before was the procedure necessary in that particular instance. The value of any surgical procedure cannot be determined by men not qualified or by the recital of experiences in which such procedure is clearly contra-indicated.

Therefore, we may assume that it has been the abuse of gastro-enterostomy rather than its proper and rational application which has brought it more or less into disfavor.

It is with full appreciation of the value of gastro-enterostomy when properly employed that I protest against its employment in every case of ulcer treated surgically.

Statistics now available from many large clinics prove most conclusively that in approximately 70 per cent of patients afflicted with cancer of the stomach, it is implanted upon an old ulcer base. It is recognized that the tissue changes which accompany chronic gastric or duodenal ulcer are more or less permanent and potentially cancerous. Rodman, recognizing this years ago, recommended that where the pyloric region was the seat of an ulcer or ulcers which presented much thickening or other evidences of malignancy, a pylorectomy be performed, and this principle for ulcers so located has been more or less generally recognized and employed.

It would appear, however, from a perusal of literature pertaining to gastric surgery and from impressions gained in attendance at various clinics, that ulcers situated in other regions of the stomach than the pylorus are not excised as frequently as they should be. With the tendency to cancer development upon an ulcer base, regardless of its location in the stomach-wall, the duty of the surgeon toward these patients is clear.

Ulcers so situated as to permit excision without particularly increasing the immediate risk of the operation should be excised. Moynihan (1) states that in reviewing his early work, when gastro-enterostomy alone was employed in the surgical treatment of ulcer, about one-third of the number of patients only could be pronounced "cured." Another third, after a varying period of freedom from symptoms, had to submit to a second operation in which a pylorectomy or excision of the ulcer was rendered necessary after which they experienced lasting relief. The remaining third developed carcinoma of the stomach from two to five years later.

His experience, which parallels that of many other surgeons, furnishes additional reason

[1] Read before the Western Surgical Association, Des Moines, December, 1915.

for the more radical treatment of ulcer at the primary operation. The fact that one-third of the number of patients with gastric ulcer who have been treated by gastro-enterostomy alone by a master of gastric surgery, require a second operation for the removal of the ulcer before obtaining complete relief from distressing symptoms, should command our earnest attention.

Because of the rich blood supply and thickness of the stomach-walls, the repair of a wound therein is rendered not only extremely easy of accomplishment, but practically certain as to prompt and firm union. Ulcers situated upon the anterior surface of the stomach and not involving the curvatures may be very readily excised and should in practically every instance be so treated.

Ulcers located in the pyloric region upon the anterior wall may as a rule be readily excised, and should such excision result in narrowing of the pylorus a gastro-enterostomy should also be made. If several ulcers are present in this region or if the thickening and induration attending one ulcer are extreme, a pylorectomy or Rodman operation should be done. Pylorectomy is a somewhat more formidable procedure than simple excision or excision and gastro-enterostomy and should be reserved for those cases where pyloric involvement is general and extensive.

Ulcers involving the lesser curvature may be excised by the method of Moynihan (2) followed by gastro-enterostomy which he states should always be done in such cases following excision because of the resulting stomach deformity. It is surprising what results may be secured by this method in ulcers involving so much tissue on either side of the curvature as would appear at first sight to render their complete removal out of the question. However, many ulcers so situated will be encountered whose complete excision is out of the question because of adhesions and extensive involvement of the stomach-wall, and in such instances we are forced to be content with gastro-enterostomy.

Ulcers upon the posterior wall of the stomach may be excised if not too adherent, either by employing the rotation method of Summers (3) or the transgastric method advocated by Chaput (4), Deaver (5), and others. I have employed both of these procedures with much satisfaction and have been surprised and gratified with the ease of their performance in suitable cases. Because of adhesion or inaccessibility, not all ulcers of the posterior wall can be excised and a gastro-enterostomy must suffice.

Ulcers high in the cardiac end of the stomach are not amenable to excision nor are they benefited by gastro-enterostomy. Jejunostomy offers the best prospect for relief to patients so afflicted.

When operating for perforation of a gastric or duodenal ulcer, excision of the tissue involved in the ulcerative process should be done whenever possible before attempting to close the rent in the stomach-wall. This removal of diseased tissue not only facilitates immediate wound repair but also lessens the tendency to recurrence.

Whenever possible after excision of an ulcer or ulcers the suture line should be reinforced by an omental graft or flap as long ago recommended by Senn, as thereby the danger of leakage is reduced to the minimum.

As experience increases it will be found that more and more ulcer-bearing tissue may be treated radically by excision even to the point of making, when necessary, a partial gastrectomy for ulcers so situated as to require the same for their removal.

Gastro-enterostomy may frequently be necessary as a supplementary procedure to excision of ulcers wherever situated and should in such instances never be neglected. Believing that the ulcer of today is the cancer of tomorrow, it is urged that in every suitable case the ulcer-bearing tissue be removed by whatever means or method is in that particular instance most safe and practical.

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THE ADVANTAGE OF SEPARATE SUTURE OF THE MUCOUS MEMBRANE IN GASTRIC SURGERY[1]

By RICHARD A. BARR, M.D., F.A.C.S., Nashville, Tennessee

IT has unfortunately been proved to the satisfaction of most observers that simple gastrojejunostomy, with its low mortality of 1.5 to 2 per cent, will be definitely curative in less than half the cases of chronic gastric ulcer and in hardly more than two-thirds of the cases of chronic duodenal ulcer that come to operation.

That many ulcers do not yield to medical treatment, and yet are permanently and completely cured by surgery (simple or complicated) is a fact as firmly established as that gastrojejunostomy is not a cure-all. More than this, that properly applied surgery can cure every existing ulcer of this region is a reasonable expectation, though the cure may be effected at a great risk.

Leaving out all consideration of cancer, actual or potential, the cure of ulcer by surgery can only be *positively* assured by resection or permanent exclusion of the involved area. Drainage and the admission of alkaline secretions into the stomach may give temporary relief of symptoms. This much may be and often is accomplished by gastrojejunostomy. An opening at the usual site of the posterior gastrojejunostomy does under some conditions (pylorospasm for instance or in case of very large stoma) hasten the emptying of the stomach and does admit the bile and pancreatic juice into the stomach. Animal experiments, X-ray observations, and average clinical results all go to prove, however, that to act advantageously a moderate sized artificial opening must be assisted by spasmodic or organic closure of the pylorus. Nature ignores to a greater or less extent the artificial opening unless obstruction exists at the natural one. This is an established fact, and many ills besides recrudesence of ulceration result from the presence and disuse of the new opening.

My own idea of the proper way to view a gastrojejunostomy is merely as a new channel for food. This new channel is necessitated by reason of the fact that cicatrization (or operation) has caused closure of the pylorus. In other words it bears somewhat the same relation to the surgery of ulcer of the stomach and duodenum that colostomy does to the surgery of cancer of the rectum.

To exert a *certainly* curative influence on an ulcer of the stomach or duodenum, surgery must either remove the ulcer or exclude the area occupied by it not only from the passage of food but even from contact with the acid gastric secretion.

These objects can be accomplished in duodenal ulcer by closure of the pylorus, in pyloric ulcer by pylorectomy or closure on the proximal side, in all others by resection of more or less of the stomach, including the pylorus in suitable cases. Where the resection does not include the pylorus it might be wise at least to occlude it for prophylactic purposes. The reasonableness of this would be more assured if we knew the etiology of ulcer more definitely. However, prompt emptying of the stomach and the admission of alkaline secretion are doubtless beneficial (experimental ulcer cannot be produced in the absence of acidity), and these can be assured by gastrojejunostomy when done as an adjunct to pyloric closure.

This statement of the case sounds extreme, and yet if we are to do anything definite for non-perforating and non-stenosing ulcers, this is almost the irreducible minimum. Fortunately most ulcers are so situated that closure at or near the pylorus will meet the indications. When pylorectomy or resection elsewhere is required, the surgical risk will not be out of proportion to that of the pathology.

In doing the limited work I have had in stomach surgery I have been torn between the conviction that only radical measures would get results, and the fear of the mortality associated with these radical measures.

The technical difficulties of resection of the

[1] Read before the Southern Surgical and Gynecological Association, Cincinnati, December 1915.

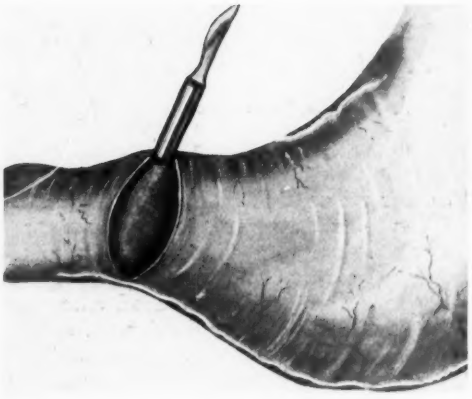

Fig. 1. The posterior surface is freed by blunt dissection with a narrow knife-handle or similar instrument.

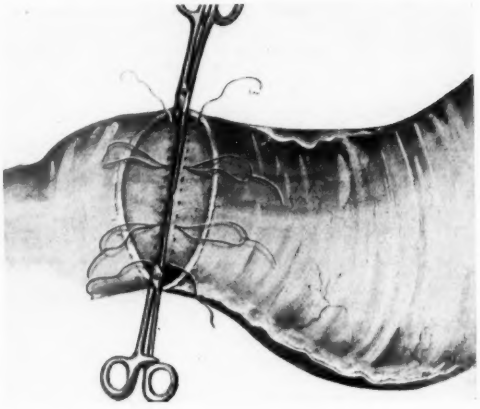

Fig. 2. Showing the ligatures of the mucous membrane about clamp.

stomach are not a negligible matter to the surgeon who does not do stomach operations every day. The satisfactory application of clamps, the thickness of the stomach-wall, and the exposure of the inner surface of the mucous membrane have been among my greatest difficulties in doing the technique as I think it should be done. By splitting the stomach-wall, so to speak, and using the mucous and submucous coats as one layer, and the serous and muscular coats as another, I have avoided these difficulties to an appreciable degree. This technique has been used to a greater or less extent by others but I do not believe its advantages have been duly appreciated.

This use of the mucous membrane is most satisfactory in occluding the pylorus. For this purpose an incision is made on the anterior surface of the stomach, or of the duodenum, according to conditions. This incision is carried down to the submucosa, which in all succeeding description will be included in the term mucous membrane. The incision should be preferably transverse to the long axis of the organ, and should extend from border to border.

When the mucous membrane is reached the overlying tissues are removed from its anterior surface for at least an inch, and for as much more as may be desirable. Then the posterior surface is freed by blunt dissection with a narrow knife-handle or some similar instrument (Fig. 1). A cylinder of mucous membrane is thus gotten up which is clamped at its center. The mucous membrane is closed just on either side of the clamp by a chain ligature of linen, tied in two or more sections as required by the width of the cylinder of mucous membrane (Fig. 2). The clamp is then removed and the mucous membrane divided along the groove left by the clamp.

When the length of the cylinder of mucous membrane permits double clamping with incision between the clamps, this should be done as it simplifies suture or ligation of the stump. When double clamping is done, I always prefer suture to ligation and use linen, which is put in with two needles just under the clamp after the fashion of a harness stitch (Fig. 3).

As the next step of the operation a purse-string of catgut or linen is thrown around the base of each stump (Fig. 4). This purse-string is put in the angle of tissue where the exposed mucous membrane terminates, and it may be placed in the mucous membrane itself, but preferably should be in the muscular tissue. The stumps are inverted and the purse-string tightened. When the width of the stomach makes a purse-string undesirable as may readily happen on the proximal side, a continued suture, approximating the anterior and posterior walls, in the inner surface of the overlying muscular coat will serve the

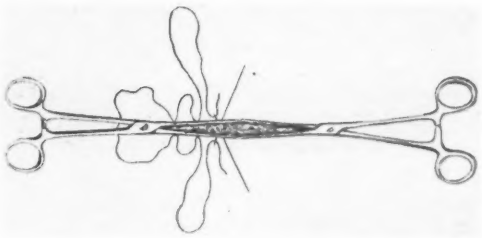

Fig. 3. Showing method of suturing when it is possible to double clamp the cylinder of mucous membrane.

same purpose. The seromuscular tissues are then closed, the edges of the wound being inverted so as to bring the peritoneum in contact with the muscle of the posterior wall, or the edges of the seromuscular wound may be brought together by sutures which also catch the posterior wall.

Instead of inverting long stumps of mucous membrane the stumps may be ligated (or preferably sutured) close to their bases and then cut short. This makes the inversion less satisfactory, but is necessary when on account of the location of the ulcer the dissection has to be carried across the face of the ulcer leaving possibly an opening in the membrane corresponding to it. Inversion of the stump gives an additional sense of security, and yet is probably not of any special value provided the mucous membrane is trimmed short.

When the ulcer is of suitable size and located on the anterior wall, it may be surrounded by crescentic incisions, running from curvature to curvature, down to but not through the mucous membrane, and the dissection and ligation of this structure completed as just described (Fig. 5).

It would appear at first glance that an incision in the long axis midway between the borders would be most satisfactory, but there are several objections to this. First the ulcer would be more difficult to avoid or to include by encircling. Then the closest attachment of the overlying structures to the mucous membrane is found at the borders, and here we get the most hæmorrhage in separating them. At the extremities of the transverse incision we have immediate access to these

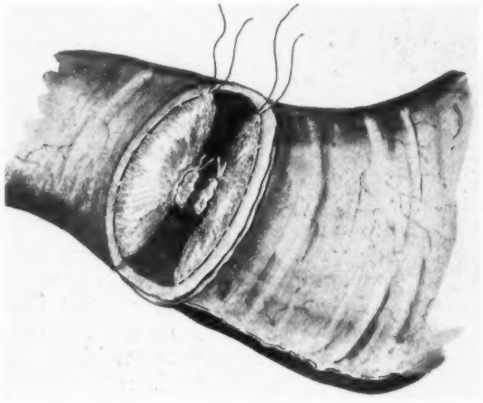

Fig. 4. A purse-string suture of catgut or linen is thrown around the base of each stump.

borders and also to the posterior surface of the mucous membrane.

In doing this little operation it will not usually be necessary to ligate the omenta at the upper and lower borders of the viscus, but this can be done if hæmorrhage is at all troublesome.

The advantage this method of occlusion has over the Biondi method and various other methods with or without dissection of the mucous membrane, is that it is more apt to be permanent, and is equally as simple as any, except the ligature methods which are least reliable.

The advantage of the procedure over von Eiselberg's exclusion is that the omenta do not have to be divided and the pylorus does not have to be mobilized. Further than this the cavity of the viscus is not opened up, and the inner surface of the mucous membrane is not exposed, to the same extent. Closing a seromuscular wound on the anterior surface of the stomach or duodenum is a very much less difficult job than closing the two openings left by division of all tissues.

There is small choice in technical difficulty between unilateral exclusion and Rodman's pylorectomy, and between these two procedures I would choose pylorectomy. The only advantage the procedure just described has over pylorectomy is that it is more easily performed, and it serves almost the same

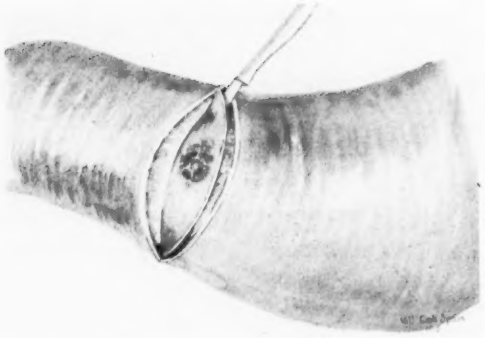

Fig. 5. Method of resecting an ulcer of suitable size on the anterior wall.

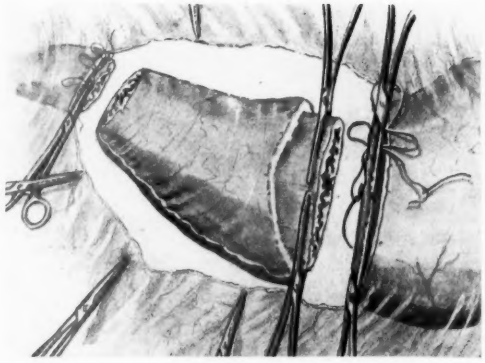

Fig. 6. Showing technique used in pylorectomy.

purpose so far as getting rid of the ulcer- and cancer-bearing area is concerned, for the pyloric mucous membrane is removed. It can be made a submuscular resection of the ulcer- and cancer-bearing, and even of what, according to recent teaching, is the acid-producing area of mucous membrane.

Should the location and extent of the ulcer at or near the pylorus or the presence of adhesions prevent the use of this technique, and yet cicatrization should not have produced an efficient and permanent stenosis, pylorectomy at some later date primary or secondary to the gastrojejunostomy is of course indicated.

In doing pylorectomy the mucous membrane can be handled in much the same way as just described. After the omenta have been tied and you are ready to divide the viscus, with or without clamping the duodenal end of the area to be resected, cut down upon the mucous membrane anteriorly and posteriorly and dissect up a short area of it as already described, for pyloric occlusion. Double clamp this mucous membrane, cut between the clamps, suture or ligate the distal end (Fig. 6), and then suture the seromuscular structures over this stump inverting the serous coat carefully.

The incision through the stomach at the opposite end of the resected area is handled in the same way (Fig. 6). The mucous membrane is closed by the harness stitch of linen already mentioned which is drawn snug as it is placed (Fig. 3). The mucous membrane may be sutured close up to its line of reflection from the muscle and cut short, but the overlying structures are more easily and smoothly closed if the mucous membrane is long enough for its suture line not to hold the anterior and posterior stomach walls too rigidly in contact.

I have found this method of closure technically much easier than the ordinary one, and that the line of closure is much smoother and less bulky. Hæmorrhage can be accurately and permanently disposed of as you proceed. Rubber-covered clamps may be used for the temporary control of hæmorrhage, and being used for this purpose alone may be loosened at any time for the detection and control of vessels that would bleed.

In performing gastrojejunostomy I use no clamps except a small Murphy clamp at either end of the proposed incision in the jejunum. It is at times difficult to get room on the stomach for a gastro-enterostomy clamp, and once applied the clamps necessitate a blind method of controlling hæmorrhage.

In the absence of clamps the viscera are held in contact and supported outside the abdominal wound by sutures which catch a good bite on each organ just beyond the limits of the proposed lines of incision. The incisions are made down to the mucous membrane, and this structure cleared for a space half an inch wide at the center of each in-

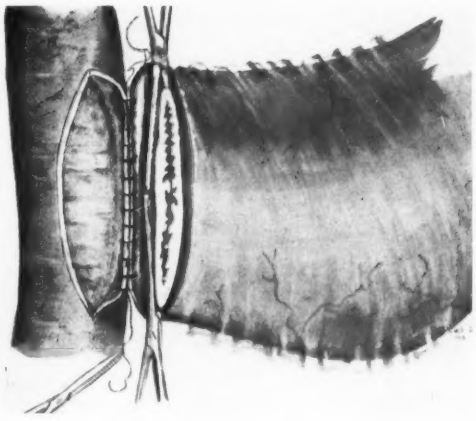

Fig. 7. Cavity of stomach held closed by clamps on mucous membrane until posterior seromuscular suture line is completed in gastrojejunostomy.

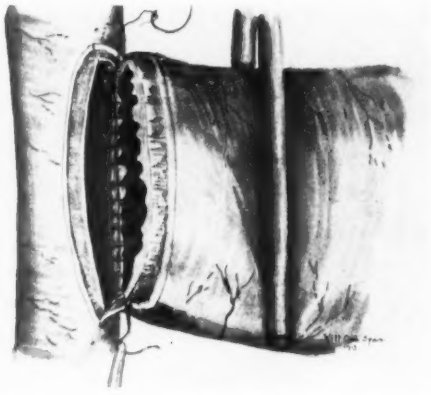

Fig. 8. Posterior seromuscular suture line completed and rubber-covered clamps in place.

cision, and tapering to the angles. The posterior cut edges of the seromuscular layers are united by a continued suture, the mucous membranes are then incised down the center of the exposed areas, the cut edges are united all the way round with a whip-over suture, and the seromuscular suture completed anteriorly. Catgut is used throughout. The inner layer of sutures placed in this way is a more simple procedure to accomplish than the usual through-and-through suture, the suture line when complete is more flexible and more readily pushed out of the way for the seromuscular suture to follow. A third line of sutures may be used if desired.

If in doing a primary pylorectomy, it is considered desirable to anastomose the cut edge of the stomach into the jejunum after the method of Polya, the resection of the stomach is carried out as already described. The union between the stomach and jejunum is made as in ordinary gastrojejunostomy (Figs. 7 and 8), except that the cavity of the stomach is kept closed by the clamps on the mucous membrane until the posterior seromuscular suture line is completed (Fig. 7), and when these are removed, by rubber-covered clamps as ordinarily used.

In the *Journal of the American Medical Association* of September 25, 1915, Dr. W. J. Mayo described a method of excision of ulcers of the body of the stomach, accessible from the serous surface and not extensive enough to demand more radical measures. A seromuscular flap is raised, the ulcer cauterized, the opening closed by sutures placed in the mucosubmucous coat, and the flap replaced with overlapping. Dr. Mayo advises gastrojejunostomy but says that blocking the pylorus has not seemed to have added anything to the operation. He gets results without blocking, but many of us cannot.

I have been experimenting on dogs with a wire snare for dividing the mucous membrane in gastrojejunostomy after the inner line of sutures has been completed both posteriorly and anteriorly except for the small space required by the snare. The snare has worked very well so far as results in dogs are concerned, but such a strain is thrown upon the sutures when the tissues are drawn upon during the crushing action of the snare that I have not tried it upon a human subject.

I will say in conclusion that unless you have given the matter special attention you probably have no idea what a tough substantial structure the mucous and submucous coats of the stomach make. The peritoneum and muscle are much more readily divided, it is easy to cut down to the submucosa and leave it intact, and the overlying structures are readily detached from it.

MELANO–EPITHELIOMA[1]

A Report of Seventy Cases

By ALBERT COMPTON BRODERS, M.D., and WILLIAM CARPENTER MacCARTY, M.D.
Rochester, Minnesota
From the Mayo Clinic

THE variety of synonyms which have been applied to pigmented malignant neoplasmata indicates a lack of uniformity of opinion as to just what these tumors are histogenetically. They have been described as "melanosarcomata," "melanocarcinomata," "melanoblastomata," "melanomata," "melano-epitheliomata," "melanotic sarcomata," and "chromatophoromata." The majority of writers utilize the term "melanosarcoma," which has its basis of usage in the old classifications of neoplasmata. These classifications were founded upon a theoretical conception of the specific origin of tissues in the three embryonic layers. The principal cells of nævi or moles, having been thought to have their origin in connective tissue of the skin, were, therefore, mesoblastic and hence their neoplastic derivatives have been called sarcomata.

The conception that the spindle and oval cells which are characteristic of melanotic neoplasmata of the skin are of connective-tissue origin, is founded upon morphology, which we are rapidly learning is not an accurate criterion for the embryologic origin in any specific embryonic layer. Morever, the direct continuity of the spindle and oval cells with the basal cells of the skin can be readily demonstrated not only in nævi (Fig. 1), but also in melanotic neoplasmata (Figs. 2, 3, 4, and 5).

The cells of the latter condition frequently assume an alveolar arrangement (Figs. 6, 7, and 8) which is very characteristic of epithelial tumors. Such alveolar growths have been called "alveolar sarcomata" and "endotheliomata," the latter term inferring their origin in the lining of vessels. In the authors' experience no evidence of vascular structure in connection with the alveolar arrangement has been demonstrable (Fig. 8).

We desire to utilize the term melano-epithelioma for the following reasons:

1. If the old three-layer hypothesis for the classification of tumors be adhered to, it may be well to remember that the pigment-bearing cells of the skin (Fig. 9) and perhaps the choroid (Fig. 10), both of which furnish the source of all of the tumors of this series, have

Fig. 1. (a91016.) A section of a mole showing the direct connection between the stratum germinativum and the subepithelial cells which are characteristic of moles.

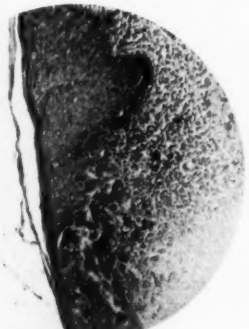

Fig. 2 (99046). Photomicrograph of an early migration of the malignant cells of the stratum germinativum in the skin of the right labium.

[1]Read before the Olmsted County (Minnesota) Medica Society, December 9 1915.

Fig. 3.

Fig. 4.

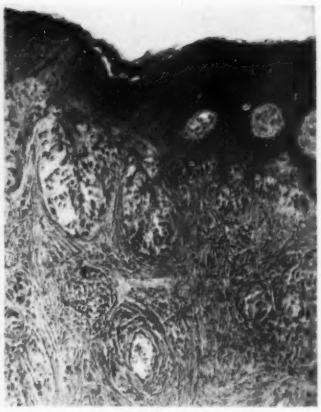

Fig. 5.

Fig. 3 (80193). Photomicrographs showing hypertrophic and hyperplastic cells of the stratum germinativum of the skin over the left groin.

Fig. 4 (80193). Photomicrographs of a portion of the same section (Fig. 3), showing a local hyperplasia with invasion by the cells of the stratum germinativum. The hypertrophic cells of the stratum germinativum are morphologically identical with the cells of the neoplasm.

Fig. 5 (80193). Photomicrograph of a typical melanoepithelioma arising in the germinal layer of the skin. The cells are in direct continuity with the stratum germinativum.

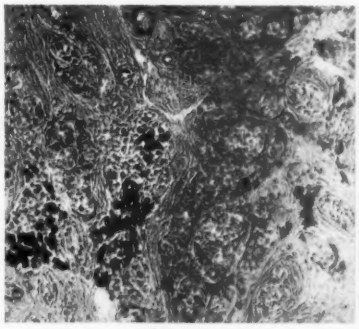

Fig. 6.

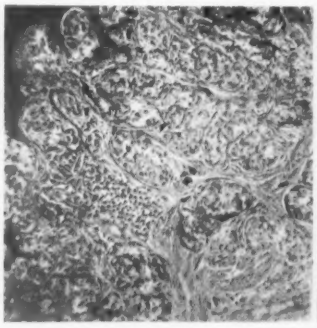

Fig. 7.

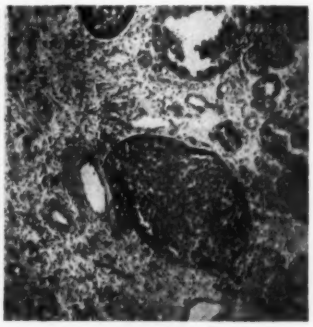

Fig. 8.

Sections (80193, 80193, and 123182 respectively) showing an alveolar arrangement of cells.

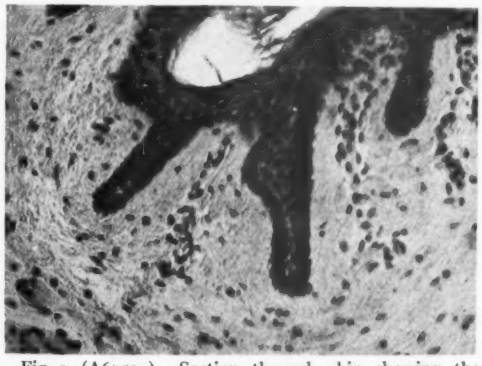

Fig. 9 (A67579). Section through skin showing the normal location of pigment cells.

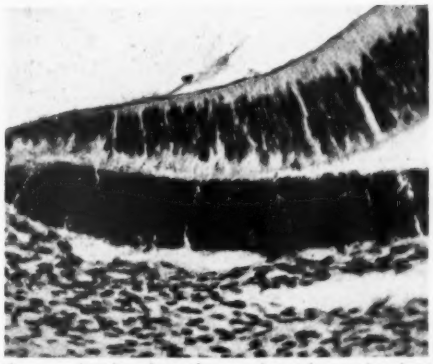

Fig. 10. Section through an embryonic eye showing the relation of the choroid to the retina.

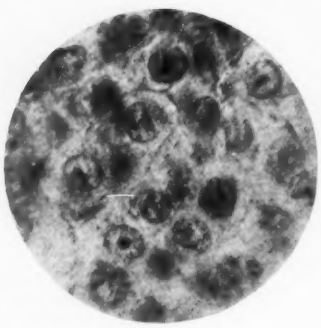

Fig. 11a.

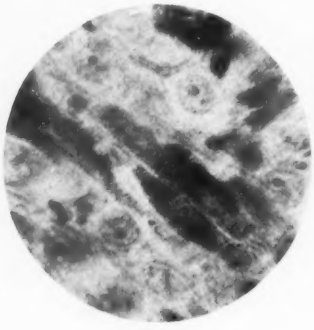

Fig. 11b.

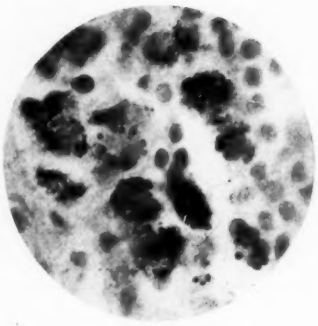

Fig. 11c.

Fig. 11 a, b, c (105603 and 36641). High power photomicrographs showing variety of cells which are found in melano-epitheliomata.

Fig. 12.

Fig. 13.

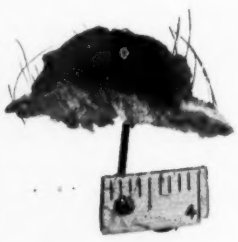

Fig. 14.

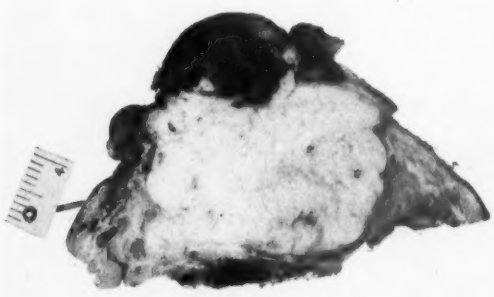

Fig. 15.

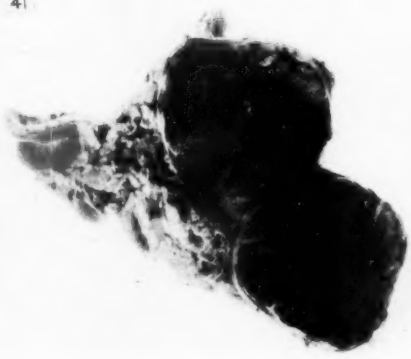

Fig. 16.

Fig. 12 (57193). A flat pigmented mole upon the inner side of right leg, metastasis in the right inguinal glands. Death within a year from operation.

Fig. 13 (123182). An elevated, almost pedunculated, pigmented malignant neoplasm upon the left internal malleolus.

Fig. 14 (70911). Gross section through a malignant pigmented hairy mole upon the right cheek. The neoplasm has not extended visibly into the subcutaneous tissues.

Fig. 15 (132905). Gross section showing the extension of a growth from a pigmented mole into the subcutaneous tissue. The growth in the subcutaneous tissue lacks pigment; location, right leg just below the knee.

Fig. 16 (143701). Metastatic growth of left axillary glands.

their origin in the ectoblastic layer rather than the mesoblastic layer. There still seems to be, however, some doubt as to the exact origin of the pigmented cells of the choroid, some authorities believing that they are a part of the embryonic optic bulb and others considering them a part of the mesoblastic tissue which lies adjacent to the retina (Fig. 10).

2. The downward growths of spindle and oval cells of moles or nævi and melanotic neoplasmata are in direct continuity with the stratum germinativum of the skin (Figs. 2, 3, 4, and 5).

3. The pigment-bearing cells of normal skin and of the downward growths of moles or nævi are in the basal layer (stratum germinativum) and not in the subjacent connective tissue (Figs. 2, 3, and 4).

4. In accord with more recent observations of the histogenesis of epithelial neoplasmata, they arise directly as a proliferation of the germinative or regenerative cells of the parenchyma of organs and not from either the differentiated cells or from "cell rests."

The cells of melano-epitheliomata may be oval (Fig. 11a) or spindle (Fig. 11b); all cells do not contain pigment (Fig. 11, a, b, c).

In our series of 70 cases the condition arose in both flat (Fig. 12) and pedunculated (Fig. 13) pigmented areas of the skin. The local growth may be discovered when there is no apparent invasion of the tissue subjacent to the pigmented nævus (Fig. 14). In the majority of cases, however, there is extension to the subjacent structures (Fig. 15). Pigment may occupy a large (Figs. 14 and 16) or small part of the tumors (Fig. 15).

The pathogenicity of this type of neoplasm may be seen to best advantage in the following tables:

1. Average age of patients, 49 years.
2. Number patients between the ages of 20 and 30 years. . . . 7
   Number patients between the ages of 30 and 40 years. . . . 13
   Number patients between the ages of 40 and 50 years. . . . 14
   Number patients between the ages of 50 and 60 years. . . . 20
   Number patients between the ages of 60 and 70 years. . . . 8
   Number patients between the ages of 70 and 80 years. . . . 7
   Number patients between the ages of 80 and 90 years. . . . 1
   Total. . . . 70
3. Oldest patient, 84 years; youngest, 21 years.
4. Average duration of lesion before examination, 11 years.[1]
5. Number of lesions which had their origin in birthmarks (nævi, warts or moles) 35 (50%)
   Number of lesions which had their origin in miscellaneous pigmented areas not typical moles 24
   Number of lesions which had their origin in the eye 4
   Number of lesions with origin unknown 7
6. Size of largest lesion was that of an orange.
   Size of smallest lesion was that of a pea.
7. The following anatomical locations of original growths were noted:

Scalp	1
Eye	4
Ear	2
Nose	1
Cheek	2
Jaw	5
Chin	1
Neck	1
Shoulder	3
Deltoid	1
Hand	2
Thumb	1
Breast	1
Chest	2
Back	3
Abdomen	1
Labium	2
Urethra	1
Groin	2
Hip	1
Thigh	2
Leg	8
Internal malleolus	1
Ankle	1
Heel	3
Foot	4
Toe	7
Not stated	7
Total	70

8. Anatomic location of metastases —
   Regional lymphatic glands . . . . 36 cases
   General . . . . 10 cases
   Liver . . . . 2 cases
   Ovary . . . . 1 case
9. Number of patients with a history of previous operation 39
10. Number of specimens excised for diagnosis 21
11. Number of correct clinical diagnoses, 41, 58.6% (out of 70 cases).
    Number of doubtful clinical diagnoses, 27, 38.6% (out of 70 cases).
    Number of incorrect clinical diagnoses, 2, 2.8% (out of 70 cases).
12. The number of patients operated on between April, 1904, and January, 1915, that have been heard from directly or indirectly by letter 38
    The mortality for patients operated on between April, 1904, and January, 1915, that have been heard from is . . . . 33 or 86.8%
    The number of patients dying within one year from last operation 24 (63.2%)
    The number of patients dying within two years from last operation 4 (10.5%)

[1] This figure is only approximately correct, on account of the patients' inability to remember both the first appearance of moles and slight changes which took place in them.

The number of patients dying within four years from last operation	1 (2.6%)
The number of patients dying within eight years from last operation	1 (2.6%)
Dead, date unknown	3 (7.9%)
Total	33

The number of patients operated on between April, 1904, and January 1, 1915, that have been heard from and are living:

1 year from last operation	2 (5.3%)
2 years from last operation	1 (2.6%)
3 years from last operation	2 (5.3%)
Total	5 (13.2%)
Dead with metastasis at end of 1 year after operation	23
Dead with metastasis at end of 2 years after operation	4
Dead with metastasis at end of 4 years after operation	1
Dead with metastasis, date unknown	1
Dead without demonstrable metastasis at last operation at end of 1 year	1
Dead without demonstrable metastasis at last operation at end of 8 years[1]	1
Dead without demonstrable metastasis at last operation, date unknown	2
Dead with demonstrable metastasis at last operation 29 out of 33	87.9%
First year deaths with demonstrable metastasis 23 out of 24	95.8%
Living with demonstrable metastasis at last operation at end of 1 year	1
Living with demonstrable metastasis at last operation at end of 2 years	1
Living without demonstrable metastasis at last operation at end of 1 year	1
Living without demonstrable metastasis at last operation at end of 3 years	2

Average duration of life after last operation, 11 months, 3 days.[2]

The conclusions which may be drawn from the above-mentioned facts are:

1. The so-called "melanosarcoma" should be called properly a melano-epithelioma when such a condition arises in the skin.

2. The condition arises as a migratory hyperplasia of the basal (regenerative or germinative) layer of the skin and invades the subcutaneous tissues and distant organs as pigmented and non-pigmented oval, spherical, or spindle cells, all of which cells are frequently found in the same specimen or even in the same microscopic slide.

3. The evolution of such neoplasmata in regenerative cells corresponds to the evolution of cancer in the skin, mammary gland, prostatic gland, and stomach.

4. The alveolar arrangement of cells in this series shows no evidence of any relation to vascular endothelium.

5. The condition is one of middle life, although it may be found from childhood to old age.

6. An attempt at determination of the exact duration of the condition from its onset to a fatal termination has failed in this series.

7. There is no specific region of the skin which seems especially predisposed to the development of melano-epitheliomata unless it is on the lower extremities, which in this series form the greatest frequency of location.

8. Nævi certainly predispose to the development of the condition.

9. Metastasis is usually to the regional lymphatic glands.

10. From an economical or practical standpoint melano-epitheliomata which arise in the skin have a high mortality.

11. Melano-epitheliomata or melanosarcomata arising in the eye have a much better prognosis than melano-epitheliomata arising in the skin.

12. From a therapeutic standpoint the pathologic history of melano-epithelioma clearly points to the necessity of an early diagnosis and a radical removal of the primary lesion and regional lymphatic glands.

13. From a prophylactic standpoint pigmented areas of skin, such as warts and nævi, should be removed when these are in locations which are or have been subjected to injury.

[1] This case possessed a melano-epithelioma or melanosarcoma which had arisen in the choroid.

[2] This figure includes the eye case which lived eight years after operation.

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GIANT URETERAL CALCULUS; ANOMALOUS DEVELOPMENT OF THE GENITO-URINARY TRACT[1]

By IRVIN ABELL, A.M., M.D., F.A.C.S., Louisville, Kentucky

THE following two recently observed cases seem to possess sufficient interest to warrant detailed report; the first, because of the size of the ureteral calculus which was removed; the second, on account of the anomalous development of the genito-urinary tract.

Case 1. F. E. B., male, white; age 32; occupation linotype operator. Date of first observation, August 17, 1915. The patient presented a negative personal history as regards any acute severe illness and also venereal infection. He applied to his physician for relief of "pain in his back," which had then been present for about ten days. He stated that he had first noted pain in the left lumbar region at the age of 18, that it had recurred at frequent intervals during the next three or four years, the attacks then becoming more irregular. At the age of 28 pain of similar character was noted in the right lumbar region. Since then the attacks have appeared on the average of once per month. The pain has never been sufficiently severe to require the administration of an opiate to secure relief, and until the present attack had not persisted longer than one or two days. Relief was usually obtained by rest in bed, supplemented by a hot bath or the application of a hot water-bottle. He also stated that, except in the last attack, relief from pain was always secured by indulgence in sexual intercourse. Between attacks the urinary frequency was four to five times daily; during an attack once to twice daily. Blood had been noted in the urine on a number of occasions. The present attack of pain began ten days previously, and had continued without remission.

Examination. Patient rather thin, but well-developed and muscular; pulse 100, temperature 100.2° F.; heart and lungs normal; right kidney easily palpable, enlarged and quite tender, apparently being as large as a medium-sized grapefruit. The left kidney was not palpable, and there was no tenderness on that side. The urine was muddy in color, acid in reaction, specific gravity 1020; it contained a marked trace of albumin, occasional blood- and pus-cells, calcium oxalate crystals, amorphous phosphates, a moderate number of bacteria.

Cystoscopy revealed a practically normal bladder. The left ureteral orifice was normal in appearance and easily admitted the catheter which was introduced without difficulty into the renal pelvis. The orifice of the right ureter was œdematous, and two and one-half centimeters from the entrance the catheter encountered an obstruction imparting a sensation like that obtained by contact of the sound with a calculus. Urine from the left kidney showed absence of albumin and pus, the presence of an occasional blood-cell. The blood-count was normal.

Radiography revealed the presence of two calculi, one in the pelvic portion of each ureter. The one in the left ureter was of moderate size, while that in the right ureter practically extended from the sacro-iliac joint to the meatus. Diagnosis: bilateral ureteral calculi with right-sided hydronephrosis.

Operation, August 19, 1915. Gridiron incisions were made upon both sides, each being enlarged downward by incising the rectus sheath. The peritoneum was displaced mesially, and the ureters approached extraperitoneally. Considerable fibrolipomatous thickening was found about the right ureter, and it was separated with difficulty from the surrounding structures. It was incised at a point corresponding to the brim of the pelvis, and the calculus removed by traction. A similar procedure was employed upon the left side, both ureteral incisions being closed by interrupted sutures of catgut. Each external wound was drained with a small strip of rubber sheeting.

The post-operative history was uneventful, the patient returning to his work at the end of the third week. The calculus removed from the right ureter was oblong in shape, with a distinct beak or curve at either extremity; it measured 7.5 cm. in length, 7 cm. in circumference at its largest part, and weighed 24 grammes. The left stone was more ovoid and weighed two grammes. The small calculus was composed of carbonate of calcium, the larger one was phosphatic in character.

The points of interest aside from the size of the calculus are bilateral pelvic ureteral calculi, an absence of colic indicating ureteral descent, the symptoms being due to urinary retention with hydro-ureter and hydronephrosis; the possibilities of intra-ureteral calculous growth on lodged nuclei of renal origin, an absence of bladder frequency or pain with practically normal appearance of mucosa, and the fibrolipomatous thickening around the pelvic portion of right ureter comparable to the induration observed in the fatty capsule of the kidney in calculous disease of long standing.

Desguin describes a male of 34 who had suffered from paroxysms of abdominal pain

[1] Read before the Southern Surgical and Gynecological Association, Cincinnati, December, 1915.

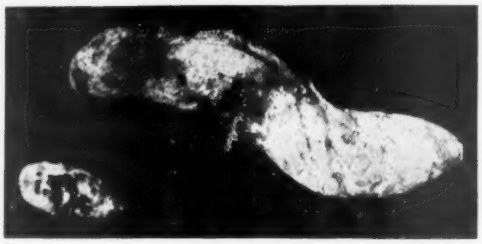

Fig. 1. Calculi, actual size, Case 1; larger one 7.5 cm. in length, 7 cm. in circumference, weight 24 gms.

since his fourth year. The patient was observed in an acute attack, and the diagnosis was between appendicitis and ureteral calculus. Abdominal incision to right of the rectus muscle; right ureteral calculus removed, irregularly triangular in shape, 26 by 23 mm., and weighing 10 grammes.

Baker refers to a male of 24 by whom he was consulted because of supposed prostatic disease, which improved under appropriate treatment, although pus in the urine persisted. An attack of ureteral colic two months later was attributed to extension of infection, but radiography revealed a concretion just above the vesico-ureteral orifice. A ureteral calculus weighing 94 grains was removed by operation.

Parker performed suprapubic cystotomy and removed a ureteral calculus weighing over three-fourths of an ounce. The patient had complained of no urinary symptoms at any time, the inconvenience suffered being referred entirely to the rectum through which the calculus was originally felt.

Bovée removed an unusually large ureteral calculus by transperitoneal ureterolithotomy. The stone measured 2.75 by 1.75 by 1.15 inches and weighed 1,310 grains. It was kidney-shaped, one extremity larger than the other, grayish in color, with rough surfaces.

Two cases of giant calculi are reported by Buerger: (a) A male of 26 presenting indefinite symptoms. Enormous ureteral calculus; hydro-ureter, ureteritis; ureteral stenosis; hydronephrosis. Calculus more than four inches in length, with a bulbous extremity pointing downward at level of the spine of the ischium. The shape was sinuous, varying from 6 mm. to about 1 cm. in diameter.

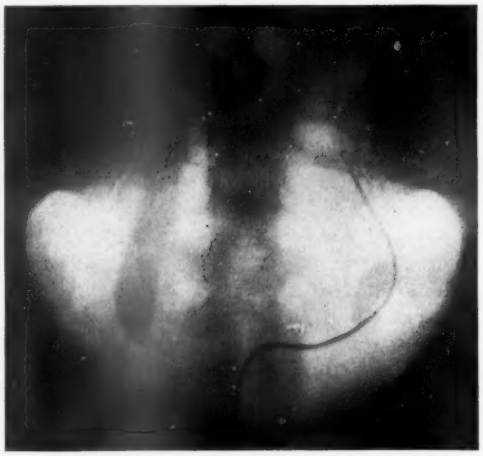

Fig. 2. Skiagram of Case 1 showing large stone filling pelvic portion of right ureter; catheter in left ureter with stone in pelvic portion of ureter.

(b) A male of 55 urinary symptoms ten years duration. Enormous ureteral calculus; hydro-ureter; hydronephrosis. Calculus irregularly ovoid with one pointed extremity, measuring 2.125 inches in length by 1.125 inches in width at its superior pole.

Specklin describes a male of 48 from whom an enormous left ureteral calculus was removed. Urinary symptoms of many years duration. Nephrectomy and ureterectomy. Curved or "elbow-shaped" calculus weighed 51 grammes, 11 cm. long from end to end, total length along outer curve 12 cm., knob-like projection in upper portion of middle third. In the literature he was able to find the following ureteral concretions of similar size: Federoff, length 19 cm., weight 52 grammes; Rovsing, length 18 cm., width of a bean; Israel, two cases, (a) length 13 cm., circumference 9 cm., weight 54.4 grammes; (b) length 17 cm., circumference 9 cm.; Pozzi, weight 34.5 grammes; Lloyd, length 5½ inches, circumference 2½ inches.

In a case recorded by Morris the calculus was nearly six inches in length; in one of Gibbon's cases the stone was half an inch in diameter and nearly round.

Case 2. P. G., female, white, age 19. Date of first observation, September 3, 1915. The patient had been married three years, but had never

been pregnant, nor had she ever menstruated. There was no history of acute illness until the present. Ten days previously she had an attack of acute pain in the lower abdomen accompanied by nausea and vomiting. The abdomen became distended and tender, the temperature varying from 101° to 103.5° F., pulse 110 to 120. The lesion was regarded by the attending physician as appendicitis. At the end of a week the symptoms had practically subsided, and she was able to leave her bed.

On September 2 the patient experienced another attack of acute abdominal pain which was also accompanied by nausea and vomiting, and she was admitted to the St. Joseph Infirmary, September 3, with a pulse of 120 and temperature of 103° F. Her abdomen was found markedly distended and exquisite tenderness was elicited over the lower zone. While her figure was typically feminine, with well-developed mammæ and wide pelvis, examination showed absence of the vagina, although the external genitals were normal in appearance. The urethra admitted the index finger, the tip entering the bladder sphincter with difficulty. Rectal examination revealed an exquisitely tender pelvic mass located chiefly on the left side. The urine was acid in reaction, there was a trace of albumin, slight sediment, a few blood-cells, many pus-cells, and rod-shaped bacilli. The blood-count showed hæmoglobin 90 per cent, white cells 30,500, with polynuclear neutrophile, 82 per cent.

From the history and the clinical findings, the most probable explanation of the pelvic mass was thought to be retained and infected menstrual secretion. Acting upon this hypothesis the abdomen was opened in the median line, and the tumor found to be a pelvic kidney situated in front and to the left of the sacro-iliac synchondrosis. Examination of both lumbar regions revealed no evidence of a second kidney. No uterus, tubes, ovaries, nor remnants of the same, could be detected. It was evident from the operative findings that the lesion was a pyelitis in the single pelvic kidney. The subsequent treatment consisted of the ordinary measures employed in such cases.

Three weeks later catheterized specimens of urine from the ureter and the bladder were found negative upon culture. Radiography after injecting the bladder and kidney with collargol showed the renal pelvis practically normal in size and shape, with one ureter which was between three and four inches in length. The ureter entered the bladder in the usual situation. No evidence of a right ureteral orifice could be found. A cystogram with the bladder in moderate distention showed that it pressed upon the kidney and that the latter produced a change in the contour as evidenced by variation in the normal rounded outline. The rectum was situated in the right side of the pelvis, and after being filled with barium was readily observed in the X-ray plate. Subsequent reports indicate that there has been no recurrence of the pyelitis.

Anders claims that congenital absence of the kidney is an exceedingly rare anomaly, and cites one case of this character. By averaging available figures, in 92,690 autopsies, the occurrence of congenital single kidney was one in 1,817. Since the publication of Moore's compilation (1898) he had found in the literature 60 cases of single kidney, which in addition to the 225 cases previously collected by Ballowitz and Moore, made a total of 285. In the personal observation cited, the left kidney, renal artery, vein, ureter, and suprarenal body were absent. He suggests that unquestionably nephrolithiasis is attended with peculiar danger to life in cases of single kidney where the ureter is occluded by calculi. It is important to remember that the vesico-ureteral orifice is generally absent on the side of the missing kidney. Cystoscopy should be supplemented by ureteral catheterization where two ureteral orifices exist, since in a small percentage of cases of congenital kidney a rudimentary ureter is present. The importance of a single kidney, from a surgical standpoint, can scarcely be overemphasized. According to Anders, advanced lesions of chronic nephritis were found in thirty-two of the fatal cases, or 42.3 per cent; undoubtedly either acute or chronic nephritis in cases of renal agenesis gives a less hopeful outlook than when developing under normal conditions, i.e., bilaterally.

Mayo states that single kidney occurs more frequently in males, whereas the so-called horseshoe kidney is encountered oftener in females. Among thirty-six cases of gross renal and ureteral anomalies observed in the Mayo clinic during a period of five years, twelve were of the horseshoe variety and six of the single type.

Thomas reports a case of pelvic kidney in a married woman of 32, diagnosed prior to operation for pelvic diseases. The vagina was about an inch in depth, and no uterus was discoverable upon palpation. The patient had never menstruated, but suffered ovarian pain every two months. A rounded, tender mass the size of an orange was detected in the left fossa. There had been frequent attacks of urinary frequency during the last

Fig. 3. Case 2. Well-developed feminine figure; absence of vagina, uterus, tubes, and ovaries; single kidney located in pelvis.

year. The patient complained of abdominal pain, especially on the left side. Cystoscopy showed the urethra and bladder normal. Left ureteral catheter arrested 2.25 inches from bladder; right side apparently normal; urine from both sides practically the same. Radiography after double injection of colloidal silver showed pelvis of hydronephrotic kidney low in left bony pelvis. The ureter was 3.5 to 4.5 inches in length.

Cullen mentions a girl of seventeen who had never menstruated. Inspection revealed absence of the vagina; rectal examination disclosed a hard, irregular mass filling right half of pelvis, thought to be uterus with retained menstrual fluid. Cœliotomy: right pelvic kidney, uterus, and left kidney absent; prolapse of tubes and ovaries in inguinal regions.

Bissell reports the successful reimplantation of a right pelvic kidney in a female of 41. When observed the patient was about eight months advanced in uterogestation; premature labor was induced, and after some delay an asphyxiated child delivered. One month later the pelvic kidney was reimplanted in its normal situation.

During routine examination of the body of a male of 30 who died of valvular cardiac disease, Ward found no trace of the right kidney. The left kidney was twice the ordinary size, with normal pelvis and ureter.

At autopsy upon the body of a female of

Fig. 4. Pyelogram. Kidney in front and to left of sacrum; hilum looking internally, convex border externally.

38 who died following a protracted debauch, Glazebrook found a single right kidney. There were two pelves and a single bifurcated ureter. The left kidney and ureter were absent. The right ureter below the bifurcation was normal in size and communicated with the bladder in the proper situation.

Stengel observed at autopsy a single kidney with two ureters, and suggested that the surgeon in such a case after using the catheter might be deceived in thinking there were two kidneys and undertake an operation; thus the only kidney might be removed. In fact a case of this character was operated upon by Polk of New York (1882), the pelvic mass removed being the right kidney. The patient lived thirteen days with complete anuria, and at autopsy it was found that this was the only kidney.

Mayer and Nelkin cite a case in which there occurred suparietal traumatic rupture of a solitary right kidney. No evidence of the left kidney could be found, although there were two ureters opening into the bladder in the normal situations. The patient died

Fig. 5. Cystogram, showing interference by kidney with normal rounded outline in distention.

Fig. 6. Showing rectum traversing right side of pelvis, Case 2.

thirty-six hours after operation. Necropsy revealed congenital absence of left kidney; traumatic rupture of right kidney; retroperitoneal hæmatoma; acute nephritis; kidney infarcts.

Secher describes the necropsy findings in a child without left kidney or ureter, the suprarenal gland being unusually large; the genital organs were also asymmetrical. He states that while about three hundred cases of single kidney have been reported in the literature of the world, these figures are misleading since distinction between total aplasia and atrophy is not always clear. The kidney was single in 7 of 8,150 cadavers examined, i.e., once in every 1,164 cases. According to the records the anomaly occurs twice as frequently in males as in females, and the left kidney is usually missing. The abdominal vessels and genital organs ordinarily display more or less deformity in such cases.

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TERATOGENESIS OF A HUMAN ATHORACIC, ACEPHALIC, ACARDIAC TRIPLET WITH NUMEROUS AGENESES[1]

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IT is with a sense of diffidence and more or less with a consciousness of temerity that I have consented to reopen a subject which has been illuminated by the contributions of the most distinguished members of scientific research. A review of the voluminous literature on this subject could not fail to impress one with the weight which is attached both here and abroad to the opinions of Ballantyne, Schwalbe, Halfeld, Keith, Thiersch, von Winckel, Frankl, Stockard, and perhaps arouse the thought that the theme is well nigh exhausted. A further and more careful review of the literature on teratology almost convinces one of the futility to contribute with entire originality. In the hope, however, of eliciting a discussion which in some degree may help to enlighten our present knowledge, this contribution is submitted.

To Dr. William F. Smith of Calexico, California, I am grateful for sending to the anatomical laboratory of the above-mentioned institution a fœtus of considerable interest from a teratological standpoint and it, together with my previous investigations, constitutes a preliminary report upon which this communication is based.

The fœtus is a female, one of triplets of 6½ months' gestation, with numerous ageneses, as is evidenced by the accompanying photograph and subsequent dissections. The other two fœtuses were males and of normal development. The monster is nine inches long and bears external evidence of the following aplasiæ, head, neck, thorax, upper extremities, and marked syndactylism of both lower extremities.

Fig. 1. Photograph of specimen.

Careful dissection of the fœtus disclosed complete acardia, asymmetry of the kidneys, the left almost twice as large as the right; absence of both adrenals, internal genitals, spleen, pancreas, and abdominal aorta. As to the alimentary canal, this was represented by a perpendicular tube in front of the vertebral column, terminating by the anal opening in the normal position.

It is agreed by all that in the human, only one embryo develops at a time, and it is equally agreed that twins are not infrequent. Indeed, even triplets and less frequently quadruplets are developed.

The most logical mode of twin production is due to a simultaneous fertilization of two ova, and also it may be brought about by the separation of a portion of a germ-plasm of a fertilized ovum into two parts, development proceeding in each part independently to full maturity, as is evidenced by experimentation on the lower animals. It is reasonable, therefore, to assume that the latter mode of twin production must take place in the very early stages of development, i. e., before the formation of the blastodermic layers, since at that time the ovum is normally already attached to the uterine wall and enveloped by the decidua capsularis. To my knowledge the literature is silent on the possibility of development of triplets or quadruplets by the separation of a fertilized ovum into three or four parts, and although the result of my experimentation on the amphibian eggs does not yet warrant positive conclusions in this respect, yet I entertain hopeful anticipation to be able to report the possibility of such mode of development in the near future.

Read before the American Association of Anatomists, at the annual meeting held at Yale University, December 28 to 30, 1915.

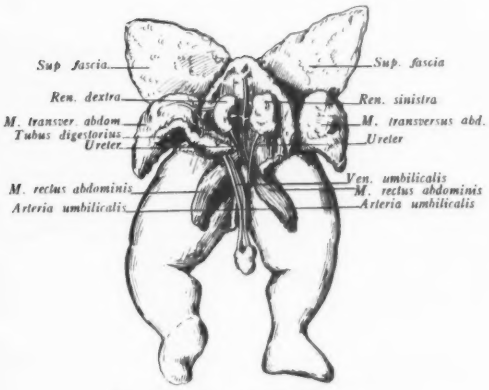

Fig. 2. Dissection of specimen.

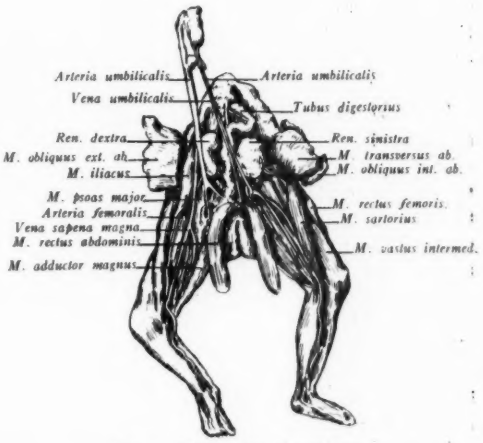

Fig. 3. Dissection of specimen.

It is an undeniable fact that twins and double monsters are always of the same sex if they are developed from a single ovum. This statement is also true in the case of triplets. In the monster under consideration, however, one of the triplets is a female, which had most probably developed from a separate fertilized ovum. Monsters are usually from twins or triplets and most frequently as a consequence of superfœtation; i. e., the presence of two or more fœtuses of different ages, not twins, due to the liberation of two ova at successive periods of ovulation. As a result, we find almost always two or more fœtuses in varying stages of development. Since the monster in this case is, except the malformations, of the same stage of development, I am rather of the opinion that its presence was due to superfecundation.

It is difficult, however, to comprehend the stage of that much development of this monster without admitting that, since careful dissection proves it an acardiac and microscopic section of the funis discloses the presence of its normal structures, the monster had derived its nourishment through the attachment of its umbilical cord either to a placenta common to the two other fœtuses, or possibly to one of the placentæ peculiar to each normal fœtus.

It is agreed by all that abnormal conditions of the uterus are among the causes contributing to retarded development, malformations, or even total destruction of the ovum or fœtus. Now, since monsters are usually born as one of twins or triplets, and, as stated above, most frequently in consequence of superfœtation, it is evident that when a fecundated ovum arrives into a uterus containing a previously implanted ovum the entire decidua has already undergone a radical histological change and hence is anything but normal. With this in mind, it is reasonable to assume that in such a decidua which largely differs histologically from a premenstrual membrane, implantation of another ovum is probably accomplished primarily with difficulty, and secondly, since implantation and subsequent development of the ovum depend largely on favorable conditions of nutrition, that implantation, if successful, has unquestionably a great aptitude to produce retarded, arrested development, or even malformations. This imperfect implantation may probably explain why, with comparatively rare exceptions, monsters of all grades are usually aborted during the primary months of gestation, although precocious entrance of the maternal blood into the intravillous space is also regarded as a probable cause.

Again, since, as I contend that monsters are produced at a very early stage of pregnancy, the possibility suggests itself that the very process of implantation of an ovum in a premenstrual membrane which has already

undergone histological changes may be entirely responsible, or at least largely a contributory factor to the causation of arrested development.

That the defect may also be due to primary faulty maturation of the ovum is suggested from the report of Ballantyne, quoted by Birnbaum, that six deformed fœtuses were born consecutively to one mother and all were of the same sex. And further, that the malformation was not due to any abnormal conditions of the uterus, fœtal membranes, or cord may be reasonably assumed from the state of preservation of the fœtus in which, excepting the marked hypertrophy of the lower limbs, no evidences of intra-uterine maceration or disintegration could be elicited.

That the enlargement of the lower limbs was due to hypertrophy and not to œdema, I am convinced from external observation and macroscopic dissection of the fœtus.

The amount of hypertrophy of the limbs, since the monster died soon (ten minutes) after birth, proves conclusively that it must have been present during intra-uterine life.

As to the cause of this marked hypertrophy, I venture to advance two main hypotheses: *first*, that it is due to a primary developmental hyperplasia, and *second*, that it is a secondary hypertrophy resulting from overexertion. The first at once supposes that the structural precedes the functional abnormality, due probably to a simple redundancy of growth. According to the second view the functional precedes and causes the structural anomaly.

It is a well-established fact that hypertrophy from repeated forcible contractions is a "property of all muscle-tissue," voluntary or involuntary, and further that tendency to normal hypertrophy is greater in the former than in the latter.

There is no proof to the contrary that hypertrophy may occur *in utero* under the same conditions as it does after birth, and, owing to the extreme activity of the processes of nutrition and growth *in utero*, it is quite possible that hypertrophy could probably take place more readily and to a greater degree *in utero*.

Again, for the proper functioning of all organs, perfect harmony of co-ordination is indispensable, and a disturbance of co-ordination of any magnitude is apt to exaggerate exertion. When, however, I conjecture what the nature of such disturbance of co-ordination can possibly be, I fear that I am perhaps getting into a region of guessing. However, I am tempted to advance the suggestion that it is possibly an intra-uterine "developmental neurosis." Assuming now, as I do assume, that a functional cause is responsible for the hypertrophy of the lower limbs, that cause I believe to be a disturbance of normal co-ordination, and, although I do not wish to lay too much stress upon this functional cause, yet no other adequate scientific suggestion has ever been advanced.

As to the causes of aplasia various scientific opinions are entertained.

Birnbaum is of the opinion that faulty and imperfect development of one-half of a twin blastoderm is the cause of malformations.

Schwalbe, on the other hand, reasons since it is accepted by all that malformations occur at a very early period of development, and since they may be caused by primary developmental defects as well as secondary degenerations, hence special investigations must be undertaken separately for every malformation, and he adds that "partial destruction of one germ may be considered as a cause," but he does not suggest how that partial destruction may possibly be brought about.

Von Winckel maintains error of development as a cause which must occur before the development of the circulatory system. Imperfect or arrested segmentation is also suggested as a cause.

F. P. Mall, quoted by E. I. Werber, holds that "faulty implantation" of an ovum in the wall of a diseased uterus, together with the inadequate nutrition arising therefrom, is responsible for defective development.

O. Hertwig, from his experiments with amphibian eggs, subjecting them to the action of a weak solution of sodium chloride, suggests that monsters in the human may possibly be due to the presence of certain poisons such as alcohol or toxins in the blood of the mother.

C. R. Stockard in a series of experiments with fish embryos, subjecting them to the

action of different chemical substances, proved beyond the shadow of a doubt that not only in the very early stages of development, but even in the late stages, deformities may be artificially produced, and although those deformities are evidently caused only by subjecting the eggs to various chemical substances, yet he justly admits that this may not be the sole cause of such defects and that any factor capable of influencing the developmental energy could possibly induce similar results.

E. I. Werber from his very recent researches on the eggs of fish, besides corroborating the findings of Stockard, suggests the possibility of some products due to pathological conditions of metabolism as a teratogenic cause.

It will be noticed that all agree on malformations occurring during the very early stages of development. While I fully coincide with Schwalbe that for each malformation a special investigation should be undertaken, yet I venture to maintain that for monsters like the one discussed in this communication, one is forced to admit not only the possibility, but a high probability, of some factor at an early stage of development to be entirely responsible for the "cutting off," as it were, of the anterior half of the embryonic rudiment.

That mechanical forces are capable of producing marked influences on early or even late developing ova or embryos is evident from the experiments of Lewis, who produced typical monsters by mechanically injuring the anterior part of the embryonic shield in the developing egg. And also, though not necessarily in every case, mechanical influences applied to developing eggs during late stages were equally productive of the same results.

On the other hand, Spemann successfully produced monsters by constricting the segmenting eggs with delicate fibers.

May it not be reasonable to suggest, therefore, that some such mechanical cause, under favorable circumstances, may produce an intra-uterine constriction of the ovum in early or late stages of development in the lower mammals and also in the human?

The most frequent variety of human monsters is holo-acardiac acephalus.

Taruffi was able to collect 108 cases, and Foerster states that acardiaci formed 18 per cent of his collected cases. In this class of monsters the entire anterior half of the body above the umbilicus is absent, and only rarely are rudiments of the missing structures present.

The morphological appearance alone of such monsters suggests the possibility of an intra-uterine factor, in the nature of a constriction, to be a responsible cause. That constriction I believe to occur in the amnion at an early stage of development, when the separation of the embryo from the blastoderm takes place, in the form of an hour-glass contraction, and, as I have intimated above, "cutting off" the anterior half of the embryonic disk. I am advancing this as an hypothesis and am inclined to believe that in future I shall be able to substantiate this hypothesis experimentally.

If now we admit the possibility of such constriction, the various aplasiæ in this, or any such similar monster, are quite apparent and do not require any further elaborations.

Careful dissection of this monster and its funis elicits the circulation in no way to differ from the usual manner of distribution of the blood-vessels in such monsters, as first pointed out by Hempel and quoted by Schwalbe, that the blood flows to the acardiacus through the umbilical arteries and returns through the umbilical veins. It must be remembered that this abnormal circulation is the product of imperfect development and not the cause.

As to the aplasia of the uterus, tubes, and ovaries, it is well known that the genital glands become the ovaries, the cephalic portions of Mueller's ducts become the fallopian tubes, and the caudal portions, since they are situated close to one another, become eventually confluent into a single tube, from the proximal part of which the uterus develops and from the distal the vagina.

From their embryology aplasiæ or malformations of these organs are easily understood. Thus, while malformations of the internal genitals may be the result of partial hindrance from growth of portions of Mueller's ducts, symmetrically or asymmetrically, aplasia must be due to complete hindrance

from growth of Mueller's ducts, or may be entirely undeveloped.

In this monster, however, since the external genitalia are present, particularly the vagina, it is evident that only the caudal portions of Mueller's ducts participated in the process of development, the cephalic portions disappearing or failing to develop entirely.

To Dr. Albert Soiland I am very grateful for the preparation of the photograph, and to Professor Charles W. Bryson, Dean, for his encouragement and facilities afforded to conduct research work.

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A CONTRIBUTION TO THE ETIOLOGY OF CANCER OF THE ŒSOPHAGUS AND STOMACH[1]

BY WILHELM LERCHE, M.D., F.A.C.S., ST. PAUL, MINNESOTA

BY the ancient Roman physicians the œsophagus was called "gula" or "stomachus," by the Greek physicians "œsophagus." Cancer of the œsophagus was probably first described by Galen in the second century under the name of *carnositas stomachi*. The Arabian physician Avenzoar (1), 1070 to 1162, had good knowledge of cancer of the œsophagus. He originated the method of feeding through a tube patients suffering with this disease, and he also introduced the method of rectal feeding in such cases.

ETIOLOGY

The discussion of the etiology in this paper is devoted particularly to the consideration of a local predisposing cause, which the writer thinks important. Cancer of the œsophagus was formerly considered a rarity and in French statistics for the Seine-Departments between 1830 and 1840, only 13 cases were found in 9,118 deaths from cancer. In the Wuerzburg statistics by Virchow (2), 1852 to 1855, the œsophagus was not counted among the organs frequently affected by cancer. In 1901 Feilchenfeld (3), on the other hand, speaks about "the remarkable frequency of cancer of the œsophagus."

HEREDITY

Bainbridge (5) sums up the question of heredity in cancer in general as follows: Heredity has been shown to play a rôle, but

[1] Read at the meeting of the Minneapolis Academy of Medicine, November 3, 1915.

not one to cause anxiety. Kraus (4), in discussing cancer of the œsophagus, says that heredity plays no important part.

GEOGRAPHICAL DISTRIBUTION

It has been stated that natives of the extremely cold regions and those of the tropics and subtropics are practically immune from cancer. Closer investigation, however, has shown that cancer is found among the Eskimos as well as in the natives of the tropics, and von Hansemann says that "there is no kind of malignant growth among us that does not occur in the natives of the tropics, and vice versa."

Trolard (6), during six years' practice in the French hospital in Saffi, Morocco, where there came about 100 patients daily, had only seen one case of cancer of the digestive tract (a case of cancer of the liver). He says that it is extremely rare among the Berbers. This has been the experience of others in Egypt and other parts of northern Africa.

In Sutherland's (7) report from Lahore, India, he states that among 43,412 patients admitted to the hospital between 1892 and 1903 there were 2 cases of cancer of the œsophagus and none of the stomach in 329 cases of carcinoma. Sutherland remarks that cancer of the stomach is rare.

Niblock (8), tabulating the records of malignant tumors in Madras General Hospital from 1892 to 1901, found 4,270 cases. Of these 976 were cases of carcinoma, of which 21 were of the stomach, and 3 of the œsophagus.

On investigation made in the Portuguese colonies (73), a total of 4 cases of cancer of the stomach and 3 cases of cancer of the œsophagus had been recorded in various hospitals, some records extending back 13 years.

Cook (9) has seen cancer of the œsophagus among the natives of Uganda, Central Africa.

Maxwell (10) found that in 11,000 patients in Changpoo Hospital in South China there were 54 cases of cancer, of which 8 were of the œsophagus (7 males, one female) and 2 of the pylorus.

At the hospital for Chinese in Tartar City, Pekin, Foulkes (11) found a fair number of cases of cancer. He mentions one case of cancer of the œsophagus.

Meldorf (12) has reported cases of cancer of the œsophagus and stomach in the natives of Greenland.

Renner (13) says that in the negroes in Sierra Leone, who as aborigines are rather free from cancer, there is increase in the cancer rate when they adopt the white man's diet and mode of living. In 22,453 cases admitted to the hospital from 1870 to 1900 there were 20 cases of malignant growth; in 10,163 cases admitted from 1900 to 1909 there were 26 cases. One case out of the 46 was cancer of the œsophagus. No case of cancer of the stomach is mentioned in the report.

In the temperate climate, which corresponds to the so-called civilized part of the world, cancer is frequent, but the statistics show that within this zone the death rate from cancer varies considerably in the various countries. Thus, according to Williams (14), Switzerland has the highest cancer rate with 132 deaths per 100,000 living inhabitants, and Hungary one of the lowest with 39 deaths per 100,000 living.

The relative frequency with which the various organs are affected by cancer varies in the different countries.

It is sometimes seen that cancer occurs more frequently in certain parts of a country: thus according to Haeberlin (15), cancer of the stomach was the cause of death in:

3 per cent of all deaths in northeast Switzerland;
1.5 to 2 per cent of all deaths in the western half of Switzerland;
1 per cent of all deaths in the southern part of Switzerland.

I have roughly figured out on the basis of

TABLE I.—CANCER OF THE ŒSOPHAGUS

	Males	Females	Ratio
Tatham (14)	2,358	852	2.77 to 1
Aschoff (19)	226	45	5 to 1
Frief (20)	288	71	4 to 1
Heiman (21)	886	125	7.1 to 1
Nencki (16)	298	57	5.2 to 1
Kraus (4)	584	188	3.1 to 1
Petri (3)	41	3	13.7 to 1
Voigt (3)	63	9	7 to 1
Gurlt (3)	78	17	4.6 to 1
Lerche	24	6	4 to 1
	4,846	1,373	3.5 to 1

TABLE II.— SHOWING THE PERCENTAGE OF CANCER IN ALL DEATHS, AND THE PERCENTAGE OF CANCER OF THE ŒSOPHAGUS AND STOMACH IN MEN AND WOMEN IN THE POST-MORTEM MATERIAL OF VARIOUS AUTHORS.

Authors	Number of Autopsies	Total Number of Carcinomata				Carcinoma of the Œsophagus				Carcinoma of the Stomach			
		Males	Females	Total	Per Cent	Males		Females		Males		Females	
						Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent
Rieck	25105 above age of 15 years	885	1,525	2,410	9.6	55	6.5	10	.7	350	39.55	363	23.28
Redlich	3,816 above age of 20 years	283	213	496	13	49	17.3	6	2.8	113	39.9	63	29.6
Feilchenfeld*		253	254	507		54	21.3	4	1.6	101	39.9	64	25.2
Reichelman	7,779	362	349	711	9.13	72	20	5	1.14	169	46.6	119	34.1
Buday	4,030 above age of 20 years	177	189	366	9.08	11	6.7			69	38.98	31	16.40
Steinhaus	4,169 above age of 20 years	194	178	372	8.87	22	11.35	5	2.8	107	55.15	51	28.65
v. Mielecki	7,186	282	234	516	7.8	45	15.9	12	5	95	33.6	61	26
Total	52,285	2,183	2,078	4,871	9.58†	254	12.92	38	2	903	42.13	688	26.33

* The cases of Feilchenfeld are not included in the sum total, as the number of autopsies was not stated. † Of all deaths.

TABLE III

	Ratio Maies to Females
Reichelman (22)	14.4 to 1
Feilchenfeld (3)	13.5 to 1
Redlich (23)	8.2 to 1
Rieck (24)	5.8 to 1
Buday (25)	11 to 1
Steinhaus (26)	4.5 to 1
v. Mielecki (27)	3.75 to 1
Harbitz (28)	3.5 to 1
Average	8 to 1

the statistics of Nencki (16) that cancer of the œsophagus was the cause of death in:

0.70 per cent of all deaths in northeast Switzerland;

0.46 per cent of all deaths in the western part of Switzerland;

0.24 per cent of all deaths in the southern part of Switzerland.

Of all cancers in men, in the District of Wangen (Canton Bern, Switzerland), 36 per cent were of the œsophagus.

Kolb (17) found that in Bavaria cancer of the œsophagus was more frequent in the northern part than in the southern part.

In Normandy, France, the rate of cancer of the stomach was very high; in the south of France it was very low.

SEX

Men are much more liable to cancer of the gullet than women. Table I shows the ratio of male to female deaths from cancer of the gullet in various mortality statistics, and in some collections of cases.

In Table II is shown the percentage of cancer in all deaths, and the percentage of cancer of the œsophagus and stomach in men and women in the post-mortem material of various authors.

In Table III is seen the proportion of deaths from cancer of the œsophagus in men and women in the autopsy material of various authors.

In men carcinoma of the stomach is the first in order of frequency in most cancer statistics, and in some statistics cancer of the œsophagus comes second.

AGE

Carcinoma of the œsophagus is a disease of middle and old age. It is comparatively rare under the age of forty.

According to Philipp (29) no case has been reported as occurring in childhood, and the youngest cases on record are probably—

Heiman's case, 19 years old; Mampell's case, 20 years old; Stewart's case, 23 years old; Slavyanis' case, 24 years old.

Table IV shows the age and sex incidence of malignant tumors of the œsophagus and stomach based on the national mortality returns, 1901 to 1903, for England and Wales.

TABLE IV

	Under 25 Years	25	35	45	55	65	75	85 and Upward	Total
Males—									
Œsophagus	1	8	125	504	752	524	185	8	2107
Stomach	13	116	527	1374	2390	2168	728	33	7349
Females—									
Œsophagus	1	37	79	140	164	207	92	5	725
Stomach	7	107	503	1289	2135	2167	830	72	7119

TABLE V

Age	Males	Females
40 to 50	4	3
50 to 60	6	2
60 to 70	12	1
70 to 80	2	

Average age, 57.3 years; youngest, 43 years; oldest, 76 years; average age in males, 59.12 years; average age in females, 51.33 years.

TABLE VI.— THE SITES OF CANCER IN THE ŒSOPHAGUS IN 30 CASES OF THE AUTHOR

Site of Cancer	Centimeters from Incisor Teeth	Number of Cases
	41	1
	40	4
	39	3
	38	3
Lower third	37	3
	35	1
	34	1
	33	1
	32	2
Total		19
	30	2
Middle third	29	1
	27	1
Total		4
Upper third	23	1
Cervical part	..	6
Total		7

Table V shows the age incidence in 30 of the author's clinical cases of cancer of the œsophagus. In each case the diagnosis was made by microscopical examination of specimen removed through the œsophagoscope.

SITE OF CANCER IN THE ŒSOPHAGUS

Any part of the œsophagus may be the site of cancer, as shown in Table VI. The question as to what parts of the organ are most frequently the sites of cancer is apparently as unsettled today as it was in the past century, some authors claiming the upper third, some the middle third, and some the lower third. Only on the basis of large statistical material can this question be settled.

In Table VII, I have brought together all the groups of cases and scattered single cases that I have been able to find in the literature.

It will be noted in this table, which has

TABLE VII.— CANCER OF THE ŒSOPHAGUS. TOTAL NUMBER OF CASES COLLECTED 4,020. ARRANGED ACCORDING TO NATIONALITY

	No. of Cases	Parts Most Frequently Involved		
		Upper Third	Middle Third	Lower Third
England—				
Habershon (30)	73	33	30	10
*Mackenzie (31)	100	44	28	28
Wright (32)	119	36	48	35
St. George Hospital (London)	50	18	10	22
*Newman (33)	445	227	98	120
Rawling (34)	214	24	163	27
*Turner (35) Autopsies	20	12	13	4
*Turner (35) Clinical	42	36	..	6
Total	1081	430	309	252
Germany—				
Petri (4)	33	2	13	18
Zenker and v. Ziemsen (4)	9	2	1	6
Colle (4)	162	15	63	84
Voigt (4)	62	4	17	41
Pigger (36)	25	3	12	10
Gottstein (37)	101	10	32	59
Sauerbruch (38)	186	26	43	117
Mampell (39) Autopsies	50	7	19	24
Mampell (39) Clinical	73	7	29	37
Hueffel (40)	50	13	20	17
Reichelman (22)	72	5	42	25
Redlich (23)	51	7	16	28
Ludewig (41)	42	3	16	23
v. Mielecki (27)	57	6	28	23
Lewin (42)	16	3	4	9
Erk (43), Engelhart (44), Rebitzer (45)	95	15	23	57
Total	1084	128	378	578
France—				
*Guisez (46)	650	300	140	210
Lamy (47)	106	11	38	57
Total	756	311	178	267
Russia—				
Krusenstern (4)	47	3	30	14
Morosow (4)	89	10	18	61
Morosow (4)	9	3	2	4
Johansen (4)	158	29	47	82
Hampeln (48) Autopsies	107	1	46	60
Hampeln (48) Clinical	128	6	12	110
Slavyanis (49)	134	20	39	75
Total	672	72	194	406
Austria—				
v. Hacker (50)	131	13	53	65
Switzerland—				
Piperkoff (51)	32	9	18	5
Loetscher (52)	93	16	41	36
Stocker (53)	34	6	12	16
Total	158	31	71	57
Norway—				
Harbitz (28)	18	4	7	7
United States—				
Lerche, collected from literature and hospital reports	89	11	32	46
Lerche (personal cases)	30	7	4	19
Total	119	18	36	65
Total	4,020	1,007	1,316	1,699
Per cent		25	32.78	42.1

* Throat specialists.

TABLE VIII.— GROUPS OF CASES FROM TABLE VII PUBLISHED BY THROAT SPECIALISTS

	Total Cases	Upper Third	Middle Third	Lower Third
Mackenzie	100	44	28	28
Newman	445	227	98	120
Turner	42	36	..	6
Guisez	650	300	140	210
Total	1,237	607	266	364
Per cent	...	49	21.5	29.4

TABLE IX.— THE BALANCE OF CASES IN TABLE VII AFTER THE CASES OF THROAT SPECIALISTS HAVE BEEN SEGREGATED

	Total Cases	Upper Third	Middle Third	Lower Third
	2,783	400	1,054	1,329
Per cent	...	14.35	37.7	47.9

been arranged according to nationality, that in the English and French groups the upper end is the part of the œsophagus most frequently involved by cancer, while in the other groups the lower part is affected in the majority of cases.

Koenig (54) in 1880, in discussing the question of the relative frequency of the seat of cancer in the upper, middle, and lower part of the œsophagus, and referring to Mackenzie's (31) cases said: "Can it really be that in England, cancer of the œsophagus is so much more frequent in the upper third?"

It has been my experience in œsophageal work that patients who locate their trouble in the upper end of the œsophagus are apt to consult the throat specialist, while those who locate their affliction in the lower part of the organ will consult the general practitioner, the surgeon, the internist, or the stomach specialist; hence the latter cases become scattered among a larger number of consultants and are not reported, because each one gets only a small number of cases. This observation seems to be borne out here, because if the cases published by the throat specialist are segregated the result is entirely different, as seen in Tables VIII and IX.

Note the striking difference between the groups of Newman, Turner, and Rawling, and the St. George Hospital, and likewise between Guisez and Lamy. Rawling says that he does not believe that cancer in the upper end of the gullet occurs in more than 10 per cent of cases. It seems reasonable to assume that if a larger number of autopsy reports from large general hospitals in England and France come forth it is likely that they will show about the same results as those of the other European countries.

Although the number of cases here brought together may not be sufficiently large to settle definitely "at what part of the œsophagus cancer most frequently occurs," it is highly probable that Table IX gives the correct answer, representing as it does the clinical and post-mortem records of large general hospitals and clinics in the various countries.

Assuming, therefore, that Table IX gives the true expression, the question immediately presents itself: Why does cancer occur more frequently in the lower part of the œsophagus than in the upper? For the sake of comparison I have analyzed 198 cases of cicatricial strictures of the œsophagus caused by swallowing corrosive fluids, and found that 18 per cent occurred in the upper part, 29.8 per cent in the middle part, and 52 per cent in the lower part of the organ. This corresponds exactly to the seats of predilection of cancer of the œsophagus. The question is whether this is a mere coincidence, or whether there is some definite physiological law that determines these so-called seats of predilection?

In a previous paper (55) I have shown that the relative frequency of the seats of cicatricial strictures of the œsophagus following the ingestion of corrosive fluids increase from above downward for the reason that the speed of the peristaltic wave, which propels the œsophageal contents, decreases from above downward, thus permitting the corrosive fluid to remain longer in contact with the œsophageal mucosa in the lower parts, with consequent deeper insult. In the lower thoracic part where the content comes to a momentary stop, the destruction is usually the most extensive, and this part is the most frequent seat of cicatricial strictures. The upper end, which is the narrowest part of the œsophagus, and where the peristaltic movement is swiftest, often escapes entirely.

The narrowest part of the œsophagus is at the inlet, and from there to the cardia the lumen increases (with slight constrictions at certain parts) so that the statement found in

most textbooks—that cicatricial strictures as well as cancer of the œsophagus are found at the physiologic constrictions, inferring that the latter are responsible for the pathologic conditions mentioned — does not seem to have sufficient foundation. Furthermore, in animals we find physiological constrictions, and yet in these cancer of that organ is extraordinarily rare.

If we now examine the stomach from a similar viewpoint, we find that in regard to the parts of the organ most frequently affected by ingested corrosive fluids, it has been observed that when a smaller quantity has been swallowed the effect is most frequently seen along the lesser curvature and in the pyloric region, particularly in the latter.

Thus Hoffman (56) describes a specimen of a stomach in which continuous 3 to 10 mm. wide streaks caused by swallowed hydrochloric acid were found along the lesser curvature from the cardia to the pyloric region. In the latter region the area of destruction was most extensive, while the rest of the stomach, with the exception of a few insignificant scars in the fundus, was normal. This corresponds to the findings of Ernest and others.

According to Aschoff (74) lesions from swallowed acids are especially found along the lesser curvature.

It seems apparent, therefore, that corrosive fluids, like other fluids swallowed, ordinarily pass from the œsophagus along the lesser curvature of the stomach to the pyloric region where the corrosive fluids remain for some time.

The reason why the fluids pass along the lesser curvature, which I have called attention to in a previous paper (68), is that the inner oblique muscular layer of the stomach contracts in such a manner as to bring the cardia and the pyloric part closer together, and to make the gastric mucosa form a trough or canal into which the fluids coming from the œsophagus are directed. This canal becomes, so to speak, a continuation of the œsophagus, and although it has already been given various names, it seems to me that the designation "gula gastrica" or "the gastric gullet" would be quite appropriate. The function of this canal has been demonstrated in the dog by Cohnheim; in the horse by Ellenberger.

In experiments on certain animals it has been observed that fluids are spurted into the stomach with considerable force, which is likely due to the contraction of the epicardia. If this is also the case in human beings, the speed with which the fluid travels would probably be greatest as it emanates from the cardia, and would decrease toward the pyloric region, with the same consequences that we have seen in the œsophagus; namely, that the upper part may escape, while in the lower part, where the speed is slowest, and especially in the pyloric region where the fluid comes to a stop, the injury is most extensive, when corrosive fluids are taken. The pyloric region is the part of the stomach most frequently and usually most severely affected by the corrosive fluid; at times it is the only part affected, the rest of the stomach, as well as the œsophagus, escaping entirely.

Thus in 59 post-mortem cases, collected by Quénu and Petit (57), in which the stomach was severely damaged from the ingested corrosive fluids, causing death, the œsophagus was simultaneously affected in 34 of the cases. In 20 cases, or 33.89 per cent, the œsophagus was not affected. In 34 less severe cases that had been collected by the same authors and that had survived the effect of the poison and had been operated upon for obstruction in the pyloric region caused by the corrosive fluid, the œsophagus was simultaneously affected in only 6 of the cases, while 28 cases or 82.3 per cent had escaped.

It is of interest to note that in the 59 post-mortems, in which the effect of the corrosive fluids caused death, the duodenum was only affected in 23.8 per cent. In none of the 34 cases of the second group was the duodenum affected.

In cattle similar observations have been made. Lichtenstern (58) found this in the post-mortem examination of 5 cows that had to be slaughtered on account of illness following the accidental feeding of hot fluid fodder. The autopsy appearances were the same in all, namely, changes confined to the omasum or third stomach, while in the rest of the stomach and œsophagus there were no changes, except in Cases 1 and 2, where parts of the tongue, pharynx, and œsophagus were also

found affected. Cases 1 and 2 stood nearest to the end where the fodder was poured into the trough. The function of the omasum is to dehydrate the food, and fluid foods pass directly into this part.

In regard to the most frequent sites of cancer in the stomach, it may be said to be a repetition of what is true of cancer and cicatricial strictures of the œsophagus; namely, "there is an increase from above downward," following, what has been referred to as the continuation of the œsophagus, "the gastric gullet." In other words the cardia, the lesser curvature, and the prepyloric part are the regions of the stomach most frequently affected by cancer, and Table X shows that this region was affected in 79.5 per cent.

TABLE X.— SHOWING THE SITUATION OF THE TUMORS IN 1,300 CASES OF CANCER OF THE STOMACH COLLECTED BY WELCH (59)

Pyloric region	701, or 60.8 per cent
Lesser curvature	148, or 11.4 per cent
Cardia	104, or 8.2 per cent
Posterior wall	68, or 5.2 per cent
Whole or greater part of stomach	61, or 4.7 per cent
Multiple tumors	45, or 3.5 per cent
Greater curvature	34, or 2.6 per cent
Anterior wall	30, or 2.3 per cent
Fundus	19, or 1.5 per cent

In Table XI, I have collected some more recent groups of autopsy cases, which show the same; namely, 78.88 per cent. It will be noticed that in the latter table the percentage of cancers of the pyloric region is somewhat lower and the percentage of cancer of the lesser curvature is somewhat higher than in Table X.

The exact starting point of the growth may be impossible to determine at autopsy, but von Mielecki (27) found in his material of 156 cases of cancer of the stomach that the center of the carcinomata occurring in the pyloric region was several finger breadths away from the pyloric sphincter, the latter being usually free.

Clinically, according to Mikulicz (62), the lesser curvature near the pylorus is the primary starting point in most cases of cancer ventriculi — probably in 40 per cent, which would correspond to the pyloric vestibule and the pyloric canal.

Von Hacker (50) in 100 cases of cancer of the œsophagus found that the lower part of the organ was affected in 49.62 per cent. Of these cases 27.49 per cent were found above the hiatus, while only 22.13 per cent were at the cardia.

It would seem then that just above and in the epicardia, and just above and in the pyloric canal, which probably are the parts regulating the evacuation of the œsophagus and stomach respectively, are the favorite seats of cicatrices from ingested corrosive fluids, because there the fluids remain the longest in contact with the mucosa. The same parts are also the favorite seats of cancer (Fig. 1).

TABLE XI.— SHOWING THE MOST FREQUENT SITE OF THE TUMOR IN 1,735 CASES OF CANCER VENTRICULI EXAMINED AFTER DEATH

Authors	Cases	Pyloric Region		Lesser Curvature		Cardia	
		Cases	Per Cent	Cases	Per Cent	Cases	Per Cent
Buday (25)	100	41	41	26	26	8	8
Steinhaus (26)	158	93	58.8	28	17.7	12	7.5
Gruber (60)	351	204	58.1	59	16.8	37	10.5
Haberfeld (61)	662	373	56.19	106	16	47	7
Redlich (23)	176	71	40.34	34	19.3	21	11.9
Reichelman (22)	288	125	43.4	51	17.7	31	10.7
Total	1,735	907	52.27	304	17.63	156	8.98

SEX

Cancer of the stomach occurs somewhat more frequently in men than in women, but in large statistics the difference is small; thus, in the statistics of Martin (63) of 20,000 cases 58 per cent were men.

AGE

Cancer ventriculi is a disease found most frequently between the ages of 40 and 70. It is comparatively rare before forty and after seventy. A number of cases have been seen in children, and it has been observed in the newborn. (see Table VII).

CANCER OF THE ŒSOPHAGUS AND STOMACH IN ANIMALS

Investigation has shown that cancer is not a disease confined to man, because it has been demonstrated in nearly all species of vertebrates including marine fish living in a state of nature. The Imperial Cancer Research Fund (64) of London, in its reports, 1905, makes the statement that the probability is that when the full facts are known the recorded incidence of cancer at all ages will

approximate in cattle and in mice that at all ages in the human subject.

The statement in regard to the cattle was apparently founded upon the reports of Veterinary Inspector Trotter, who in 1902 found 27 cases of malignant new-growths in 62,935 cattle of all ages and in 1903 found 131 cases of malignant new-growths in 47,362 cattle of all ages slaughtered in Glasgow. Nearly all of the cases were found in old cows imported from Ireland.

The Research Fund also reported 3 specimens of cancer of the stomach in cows examined by them in 1903. On the basis of these reports it has been stated in more recent literature that cancer of the stomach is common in cattle.

In the statistics of Sticker's (65), based upon the reports from the Berlin Veterinary school and the Berlin and the Munich Statistic-Pathologic Institutes for a period of 22 years, together with extensive search of the literature there were:

8 cases of cancer of the stomach in horses;
1 case of cancer of the œsophagus in a horse;
1 case of cancer of the stomach in cattle;
1 case of cancer of the stomach in a dog.

Schmey (66) has recently reported a case of cancer of the stomach in a monkey 8 to 10 years old, which corresponds to the age of 40 years in man.

To the United States Bureau of Animal Industry during the months of November and December, 1914, and January and February, 1915, there had been reported 94 cases of carcinoma and sarcoma in a total of 2,350,000 cattle killed, or 0.004 per cent. There was no information given about the site of the tumors. The number of "canners" or old cows, from the age of 8 to 15 years or older, killed, amounts, roughly estimated, to about 25 per cent of the total in some slaughter establishments—probably in all of them.

Not infrequently, and for various reasons, the viscera are condemned as food products and are disposed of without complete inspection. As such viscera might harbor malignant growths nothing conclusive can be drawn from the above reports. According to the experience of meat inspectors, however, cancer of the stomach in cattle must be very rare.

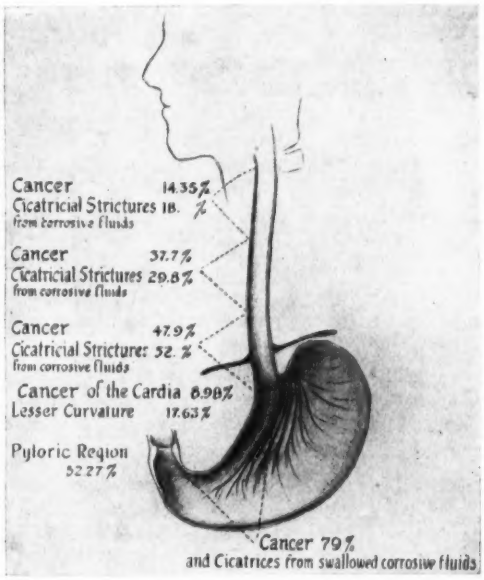

Fig. 1. Schematic drawing showing the inner oblique muscle layer of the stomach and the "gastric gullet"; also the relative frequency with which cancer and cicatricial stricture occur in the various parts of the œsophagus and stomach.

In 2,647 wild animals under observation in the New York Zoological Park (67), during five years, but one case of true neoplasm occurred; namely, a sarcoma of the ovary in a raccoon dog. Seven hundred forty-four of these animals came to complete autopsy.

With the exception of the one case in a horse, mentioned above, I have found no report of cancer of the œsophagus in animals in the literature.

SUMMARY

A brief summary of what has been said so far in this paper shows that—

1. Cancer of the œsophagus is exceedingly rare in animals.
2. Cancer of the stomach is rare in animals.
3. Cancer of the œsophagus and stomach is comparatively rare in the natives of the tropical and subtropical countries.
4. Cancer of the œsophagus and stomach is common in certain countries in the temper-

ate climate zone, inhabited by so-called civilized man.

5. Cancer of the œsophagus is much more frequent in men than in women.

6. Cancer of the stomach occurs with almost equal frequency in both sexes.

7. Cicatricial strictures of the œsophagus and the stomach, from swallowed corrosive fluids, particularly form at certain parts of those organs and *for definite physiological reasons.*

8. The favorite sites of cancer in the œsophagus and in the stomach correspond exactly to the favorite sites of the cicatricial strictures in those organs.

It seems, then, that although any vertebrate organism may be the subject of cancer, and that cancer of the œsophagus and stomach may occur in any race, civilized man in particular is peculiarly liable to cancer of those organs. Why?

Naturally the food and drink passing into the œsophagus and stomach suggest themselves for investigation, and a great many articles of food and drink — particularly meat and alcohol — have been put down, by various writers, as predisposing causes of cancer. The importance of some of these articles has possibly been overestimated; on the other hand some authors are inclined to go to the other extreme and disregard food and drink as possible predisposing causes. Mackenzie (31) in 1880 said: "Nearly a century and a half ago Van Swieten was disposed to attribute the origin of cancer of the gullet to swallowing very hot fluids, especially coffee, which at that time was coming into general use. This view, however, was no doubt erroneous and was strongly opposed by Morgagni." Perhaps the view of Van Swieten was not erroneous after all.

It is said that the X-rays have been responsible for the production of cancer of the skin in some cases, and that in the wearers of Kangri baskets, in the smokers of short clay pipes, the chronic irritation produced by those habits has been responsible for the growth of cancer.

There is a reason why cancer of the œsophagus and the stomach is so common among the inhabitants of certain countries in the temperate climate zone.

There is a definite reason why 79 per cent of all cancers of the stomach occur in the small area comprising the cardia, the lesser curvature and the prepyloric region.

May not chronic irritation caused by the large quantities of hot fluids habitually consumed by civilized man, and the mechanism directing the fluids into the "gastric gullet" be responsible?[1]

That cicatrices from swallowed corrosive fluids are especially found along the lesser curvature points to the possibility that fluids may have something to do with the fact that most of the tumors of the stomach are found in this very region — "the highway of the fluids."

Habitual local application of undue heat, causing chronic irritation, appears to be inducive to malignant changes of the tissues in other parts of the body; may not this also be the case in the stomach? If this view is correct it carries with it the conclusion that the hot fluids are also the main predisposing cause of cancer of the œsophagus.

When I say hot fluids, I do not mean to the exclusion of hot solid or semi-solid food, but as these latter are more or less masticated and mixed with saliva, the temperature of such a bolus may be somewhat reduced by the time it reaches the œsophagus and stomach. Furthermore, solid food is probably not directed along the lesser curvature to the pyloric part, the area in which the majority of gastric cancers are found.

The hot fluid, on the other hand, is quickly swallowed and on entering the œsophagus passes swiftly along the upper part of the organ, slower through the lower half, and after coming to a momentary stop above the epicardia is propelled into the stomach, where it passes along the "gastric gullet," as outlined, and comes to a halt in the prepyloric part. As the fluid travels swiftly through the œsophagus its temperature has probably not become much reduced by the time it reaches the highly specialized epithelial lining of the stomach.[2]

[1] The probable relation of the function of the "gastric gullet" to the pathology of the lesser curvature I have alluded to in a previous paper (68).

[2] Very hot or very cold drink may be retarded in its passage through the œsophagus by the spastic contraction liable to be set up by extremes of temperature, hence the mucous membrane may be exposed longer than normally.

Fluids like coffee, tea, soups, etc., are habitually taken at a temperature that would be unbearable to the skin, and the frequent travel of very hot fluids through the œsophagus and along the gastric gullet may have the same effect upon these parts as the heat from the "Kangri basket" has on the skin of the abdomen of the natives of Kashmir, India (69). These people wear a basket containing a small vessel with burning charcoal next to the skin of the abdomen during the cold weather, and the chronic irritation from this heat is considered the cause of the epitheliomata of the skin of the lower abdomen and thighs so frequently seen among them.

As mentioned before in this paper, men are more liable to cancer of the œsophagus than women — probably about in the proportion of 3.5 to 1. On the other hand, carcinoma of the stomach occurs with almost equal frequency in the sexes, although somewhat more frequent in men.

How can this phenomenon be explained? I think by the difference in the mode of drinking in men and women. While men commonly take large swallows, and often drink hurriedly, women almost invariably sip fluids and eat and drink more slowly. Consequently in women only a small quantity at the time passes swiftly through the œsophagus. When the hot fluid reaches the stomach, however, it strikes the highly specialized epithelium of less resistance than that of the œsophagus, and coming to a stop in the prepyloric region, the benefit of the smaller swallow, which saves the œsophagus, is eliminated and both sexes are practically on the same footing. The epithelial lining of the œsophagus, covered as it is with mucus, may escape the effect of the heat in a small, swiftly moving quantity of fluid, while large swallows taken at short intervals do damage by longer exposure.

This is well illustrated by the effect of a small quantity of corrosive fluid swallowed, as mentioned earlier in this paper, which will often leave the entire œsophagus intact and only attack the lesser curvature and the prepyloric region or the prepyloric region only.

Thus it may be said that the pathology of the lesser curvature indicates that the physiological function of the "gastric gullet," according to the theory of Retzius, is correct. Vice versa it may be said that the physiological function of the gastric gullet tends to support the hypothesis that fluids causing chronic irritation, particularly hot fluids, may be responsible for the lesions of this part of the stomach, as well as that of the œsophagus.

Judging from the cases of Petit and Quénu the pylorus ordinarily does not permit the immediate passage of corrosive fluids into the duodenum. In the 23.8 per cent of the cases of the first group in which the duodenum was affected the corrosive fluids had probably overwhelmed the pyloric regulating apparatus and paralyzed it to such an extent as to interfere with its normal action.

According to Mueller (75), the temperature of fluids entering the stomach much above or much below the body temperature is quite rapidly modified, and the fluids are not permitted to pass into the duodenum until they have attained a temperature approximately that of the body's.

The pars pylorica, therefore, is apparently also an apparatus of protection for the delicate duodenum. The latter organ has the benefit of the protecting and modifying functions of the stomach and it receives the contents of that organ in a condition for which it is physiologically adapted, thus escaping the chronic irritation to which the œsophagus and stomach are exposed. That this has something to do with the relative freedom from cancer which the duodenum enjoys seems highly probable.

In light of what has just been said, it is of interest to compare the cancer statistics of the north and south of Europe, taking for examples those of Norway and Italy. The Norwegians are one of the healthiest races in the world, according to the death rate during the last decade. The cancer rate, however, is comparatively high; namely, 92 per 100,000 population.

Recent statistics by Munch Soegaard (70) show that cancer of the stomach in the rural districts of Norway is 65.3 per cent of all cancers, or 70 per 100,000 population.[1]

[1] Unfortunately the death rate of cancer of the œsophagus is not specified in these statistics, but classed under "other organs."

It is interesting to note that cancer of the female generative organs in the rural districts was only 5.5 per cent of all cancers, which is unusually low (see Table XII). It is pointed out by Soegaard that cervical laceration must be frequent, as the peasants usually have large families. On the other hand, gonorrhœal infection is practically unknown among them.

The cancer rate in Italy is one of the lowest in Europe; it was 52 per 100,000 living inhabitants in 1899 (14). An analysis of the statistics (71) shows that cancer in general is less frequent in the south than in the north of Italy. This is particularly the case with cancer of the gastro-intestinal tract, and especially of the œsophagus and stomach. Cancer of the œsophagus and stomach combined, was 14.5 per 100,000 population. If the north and the south of Italy are considered separately, however, we find that the nine northern compartimenti show 19.8 per 100,000 living inhabitants, while the seven southern compartimenti, including Sicily and Sardina, showed only 5.3 per 100,000 population of cancer ventriculi and œsophagi combined, or nearly four times as many in the north as in the south. The death rate from cancer of the female generative organs in Italy was 8 per 100,000 population, but of this the north showed 9.8 per 100,000 inhabitants while the south had 5.8 (Table XIII). The difference between the death rate of the north and the south of Italy in cancer of the female generative organs is therefore not nearly so striking as the difference between the north and the south in regard to cancer of the œsophagus and stomach.

The death rate from cancer of the female generative organs in the rural districts of Norway was 6 per 100,000 living inhabitants, which is equal to the lowest in Italy. In other words, while cancer of the stomach in Norway, according to the statistics, was several times as frequent as in Italy, cancer of the other organs occurred with about equal frequency in both countries. In Norway (72) the consumption of meat and alcohol is low; the consumption of coffee is excessively high (12.25 pounds of coffee and 0.12 pounds of tea per head per annum). In Italy (72) the consumption of coffee and tea is very low; (1.61 pounds of coffee and 0.005 pounds of tea per head per annum). The climate of southern Italy is nearly tropical.

In the Norwegian rural districts hot coffee, in large quantities, is taken four to five times a day. The same is said to be the custom in the northeast part of Switzerland, and in certain parts of the latter country, hot coffee with brandy is said to be a favorite drink.

TABLE XII.— RURAL DISTRICTS OF NORWAY

Cancer of the stomach per 100,000 population	70
Percentage	65.3
Cancer of the female generative organs	6
Percentage	5.5

TABLE XIII.— ITALY

Cancer of the œsophagus and stomach per 100,000 population—	
Italy	14.5
North Italy	19.8
South Italy	5.3
Cancer of the female generative organs per 100,000 population—	
Italy	8
North Italy	9.8
South Italy	5.8

In the first part of this paper we have shown the percentage of cancer of the stomach and cancer of the œsophagus in all deaths in various parts of Switzerland. In the south of Switzerland the population is almost entirely Italian; in the western cantons the French predominate and in the northeast part the Germans. Again we see that the Italians are less prone to cancer of the œsophagus and stomach.

On the whole, cancer of the œsophagus and stomach seems to be much less prevalent among the natives of the tropical and subtropical countries; probably for the reason that a hot climate is inducive to frugality in diet in general and therefore the habit of taking large quantities of hot fluids is less likely to form.

CONCLUSIONS

1. Cancer of the œsophagus and stomach is peculiarly prevalent among the inhabitants of the temperate climate zone.

2. The relative frequency with which cicatricial strictures from swallowed corrosive fluids occur in the various parts of the œsophagus increases from above downward; in other words, the widest parts of the œsophagus are the most frequent sites of such strictures — and for physiological reasons.

3. The distribution of cancer in the œsoph-

agus corresponds to that of the cicatricial strictures from swallowed corrosive fluids, and in all probability for the same physiological reasons.

4. Any part of the œsophagus and stomach may be the starting point of cancer with the exception of the pyloric sphincter, which rarely seems to be the primary focus. The organ immediately beyond, namely, the duodenum, is practically immune from cancer. The reason for the two latter phenomena is probably that the ingesta do not reach the pyloric sphincter until they are properly modified.

5. In view of the foregoing conclusions, it seems logical to look to the ingesta of civilized man for the source of chronic irritation, which leads to malignant changes of the œsophagus.

6. The supposition that swallowed fluids after emanating from the cardia are directed along the "gastric gullet" to the prepyloric region, is strongly supported by the fact that the cicatrices from smaller quantities of swallowed corrosive fluids are usually found along this path.

7. Seventy-nine per cent of cancer of the stomach are also found along this path — the cardia, the "gastric gullet" and the prepyloric region.

8. As cancer of the stomach follows the "highway of the fluids" it seems logical to assume that ingested fluids in particular, may be responsible.

9. Alcohol and other irritating fluids probably play a part, but in the opinion of the writer "hot fluids," so universally taken throughout the temperate climate zone, in the form of coffee, tea, soups, etc., and giving rise to chronic irritation, is the main predisposing cause of cancer of the œsophagus and stomach.

10. Cancer of the œsophagus occurs less often in women than in men, because women drink more slowly and take smaller swallows, which pass quickly through, thus saving the œsophagus, while the less resistant mucosa of the stomach, where the fluids come to a stop, is more equally exposed in both sexes.

11. The fact, therefore, that the ratio of cancer of the œsophagus in men and women is 3.5 to 1, while cancer of the stomach occurs with almost equal frequency in both sexes, points strongly to "hot fluids" as the important predisposing cause.

12. This is further substantiated by the results of a comparison between the cancer statistics and the habits of the people in the north and south of Europe, by the relative freedom from cancer of the œsophagus and stomach enjoyed by the aborigines of hot climates and the extremely rare occurrence of cancer of the œsophagus in animals.

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RUPTURE OF BLADDER ASSOCIATED WITH FRACTURE OF PELVIS

With Bibliography and Report of One Case

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PROGNOSIS in intraperitoneal rupture of the bladder is as a rule either very good or very bad. The injury is either promptly diagnosed and successfully repaired, or it is unrecognized or unsuccessfully treated and death from peritonitis follows in a few days.

In extraperitoneal rupture death does not usually come within the first three or four days even if the treatment has been inefficient or absent. The urine infiltrates through the soft parts in front, below, and behind the bladder and eventually comes to the surface through the inguinal canal, through the femoral opening, in the perineum, or the prevesical space, and is then often afforded an exit by incisions through the skin. All the urine may not extravasate into the tissues. The extravesical tension may become so great that a large amount of urine accumulates in the bladder and is thence evacuated normally or withdrawn by catheter. Prognosis so far as immediate mortality is concerned is not, therefore, as bad as in intraperitoneal rupture. In point of morbidity, however, the writer believes with Fuller[1] that most patients with extraperitoneal rupture of the bladder are left seriously invalided for life.

The invalidism is due to several causes. The extravasation of urine is followed by infection, suppuration, and necrosis. The sloughing may become very extensive and, in case of "recovery," lead to cicatrization, contraction, and loss of normal function of ureter, bladder, urethra, or sexual mechanism. Another cause of more or less permanent disability is fracture of the pelvis, which very often is associated with ruptured bladder. The bladder is perforated by a splinter of the fractured bone in most instances. But the two accidents, fracture and bladder laceration, may occur separately though from the same accident, the overfilled bladder rupturing from a continuation of the force which caused pelvic fracture with wide separation of the fragments. This undoubtedly took place in my own case reported below. Even if the fracture is not in contiguity with the bladder wound, the extravasated urine is likely sooner or later to invade the site of fracture and to complicate it by adding infection.

Bladder laceration and pelvic fracture present for treatment two separate and very grave lesions. A study of the authorities shows a uniformity of opinion that the bladder should be drained promptly, suprapubically by preference, though a retention catheter in the urethra has served the same purpose in many cases. Suture of the tear is often unnecessary when the bladder is efficiently drained. On the other hand, in the management of the bone fragments no such definite plan has been employed, but most cases have been disposed of simply by applying a "tight bandage about the hips." Direct treatment of the fragments by suture, wiring, etc., has been practiced on a few occasions but found unsatisfactory in the presence of urine and infection at the seat of fracture. Indirect fixation of the pelvic bone fragments by means of percutaneous screws and external clamps at points distant from the fracture and extravasated urine, has not previously been described. The usefulness of this method is shown by the following report:

A boy, 16 years old, was brought to the hospital thirteen hours after the accident. While leading a colt with a long rope, the colt broke away and ran, dragging the boy about four hundred feet by the rope which had become entangled about the boy's right leg. The boy got up and stumbled along for several hundred feet before he fell unconscious. He had no recollection later of having walked or of anything that had happened after the horse made the first few jumps. It was noticed that urine and blood escaped profusely through a perineal wound. Since regaining consciousness some two or three hours later, he had had a constant, severe pain, chiefly in the sacral region.

[1] J. Am. M. Ass., 1914, lxiii, p. 2114.

On examination he was found to suffer from shock and loss of blood, seemed conscious, and complained of extreme pain in the pelvis. The left scapula was fractured transversely. There was a wide separation of the symphysis pubis and the entire left os innominatum could be moved about freely upon the sacrum. A lacerated wound in the perineum, two inches long and located to the left of raphé, had torn through the anal mucous membrane, sphincter ani, and muscle wall of rectum upward for an inch. This wound extended around the urethra to the left and opened into a large cavity bounded in front by the separated pubic bone fragments and the recti muscles, above and behind by peritoneum stripped loose from the abdominal wall and limited below by the collapsed bladder which was torn loose from its pubic attachments. A two and one-half inch curved laceration encircled two-thirds of the neck of the bladder on the left side. X-ray plates showed that outside of the separation of the symphysis and a marked separation of the left sacro-iliac joint, there was on further fracture of the pelvic bones.

A few hours later, after recovery from shock, operation was performed. The bladder wound was sutured with one row of eight interrupted chromic catgut sutures. Three similar sutures closed the sphincter and rectal wall. The perineal wound was partly closed, a rubber drain placed in front of the bladder and a permanent catheter through the urethra. The separation of the pubic bones was so marked and the fragments were so extremely movable that it was evident that some fixation of the bony pelvis was necessary. An attempt at tight strapping about the hips had been found inefficient to hold the symphysis together and to control the excruciating pain in the sacro-iliac region. The expedient of external fixation of the fragments by means of Freeman's screws and clamp was then adopted. A small incision was made on each side of the symphysis through healthy tissues, down to the bodies of the pubic bones, and the screws inserted. The bones were approximated and the external clamp applied.

The pain in the back subsided rapidly after the bone fixation. The perineal wound, however, was infected from the beginning, the bowels having moved involuntarily both before and after the operation. All urine came through the urethral catheter during the first week. It was bloody, purulent and filled with motile bacteria. The general condition improved steadily and the wound healed with surprising rapidity. Daily acetic acid irrigations of the bladder were employed to prevent incrustations. On the eighth day a urinary leakage through the perineum appeared. This increased in amount until the fifteenth day when the catheter was permanently withdrawn from the urethra. Natural urination began at once and increased in volume so that at the end of the first month there was but a slight perineal leakage. A small fistula through which a little urine discharged every five or six days, persisted for several months, but finally healed entirely.

The Freeman screws in the pubic bones loosened and were removed on the twelfth day and a sacro-iliac belt applied. Bony union was not expected in the presence of infection but the bones were held in fair approximation while a firm and serviceable fibrous union was established.

The patient left the hospital after nine weeks' treatment. His urine was still purulent and a slight perineal fistula was present, but he was able to walk and had a partial control which enabled him to hold his urine for an hour or two at a time.

A recent letter, two years after the accident, states that he occasionally has a partial urinary incontinence while in the erect position, but he has perfect continence during the entire night, is free from pain, has "puissance," and is in good general health. He belongs to the class which has "recovered," although he is not fully cured. The tendency to incontinence is undoubtedly due to a retraction in the cicatrix at the bladder neck which interferes with the sphincteric function when he is standing.

The writer has conducted what is believed to be a fairly complete search of the literature and collected 126 cases of rupture of the bladder associated with fracture of the pelvis, a synopsis of which is submitted herewith. In the majority of these cases it was found that a spicule of bone had perforated the bladder. Most lacerations thus caused were extraperitoneal and several were multiple. With the exception of the instances where a foreign body had entered the pelvis from without (gunshot, etc.) only four cases in which a lacerated bladder communicated with the outside have previously been described.

The treatment of the fracture itself is mentioned in only a few of the reported cases. With two or three exceptions it has evidently been limited to the application of a bandage around the pelvis, after, possibly some readjustment of the fragments. The treatment has often been seriously complicated by infection and necrosis of the bone.

Of the 127 cases now reported, 34 "recovered," making a total mortality of 74 per cent. But of these were 83 cases reported before 1890, with a mortality of 72, or 86.7 per cent. Of 44 cases since 1890; i.e., during the period of aseptic surgery, 23 lived—a mortality of less than 48 per cent. As a further proof of the increasing efficiency of

scientific surgical treatment in this class of injuries, we may note that out of 21 cases reported since 1905, only 8 died, reducing the mortality to 38 per cent. No doubt this figure may be discounted to some extent by an increasing tendency to report only successful cases. The earlier reports were largely from autopsy protocols.

The total mortality in all varieties of bladder ruptures which have been treated surgically since 1900, is less than 25 per cent. This shows in figures the extreme gravity of the lesions under discussion and indicates that fracture of the pelvis is the most serious complication of a ruptured bladder.

There is no reliable method of learning the facts about post-operative invalidism in these cases, but it is to be hoped that with the general advance in surgical technique the ratio of improvement in results in the "recovered" patients may become equal to the improvement in mortality.

SYNOPSIS OF CASES OF RUPTURE OF THE BLADDER ASSOCIATED WITH FRACTURE OF THE PELVIS

Case 1. Ollenroth, 1795, in Lesur's Thesis de doct., Par., 1888. The patient, a male, was crushed under a wall and as a result there was a rupture of the anterior part of the bladder and the symphysis pubis was separated. The patient died 56 hours later. Autopsy: infiltration of urine; peritonitis.

Case 2. Liston, Lond. Med. Gaz., 1830, vii, 29. A boy of 12 was run over by a wagon and died after 3 days. Autopsy: urine in pelvis; fracture of ischium and pubis; bone splinter perforated bladder anteriorly.

Case 3. Earle, in Med. Chir., Tr., 1833, 257. A male of 60 fell from a horse. Blood obtained by catheterization. Perineal incision made. Patient died in 40 hours. Autopsy: separation of symphysis pubis and sacro-iliac synchondrosis; urine in perineum; prostate torn from bladder.

Case 4. Nivet, Bull. Soc. anat. de Par., 1837, 194. A female, aged 16, was crushed between a wagon and a wall; urine oozed from a wound in the groin. She died after 12 hours. Autopsy: infiltration; peritonitis; extraperitoneal rupture of bladder neck; fracture of pubis.

Case 5. Hall, Prov. Med. Jour., Lond., 1843. A man was run over by a wagon. On catheterization the bladder was found to be empty; retention catheter; this patient died after 48 hours. Autopsy: separation of symphysis pubis; right os pubis fractured and bladder perforated; ilium fractured.

Case 6. Syme (1843), Lancet, Lond., 1848, i, 287. Male, aged 32, fell while drunk; he could not urinate and blood only was obtained by catheterization. He died in 12 hours. Autopsy: rupture in fundus of bladder; separation of symphysis pubis; blood in scrotum.

Case 7. Lowe (1845), St. Bartholomew's Hosp. (Lond.) Report, 1891, xxvi. A male, aged 19, was crushed under a wheel and sustained a rupture in the anterior wall of the bladder, separation of sacro-iliac synchondrosis and infiltration. Catheter introduced; incisions on dorsum of penis, sides of scrotum, and thighs were made; iliac abscesses were opened at the end of 7 months. Patient went to work two years later; living 45 years later.

Case 8. Lyon, Arch. gén. de med., 1845, vii. A boy of 14 was crushed under a wheel. Retention of urine. Perineal incision after 24 hours, bloody urine found. He died after 5 days. Autopsy: blood in peritoneal cavity; rupture of bladder on right side; fracture of right cotyloid cavity; separation of ischium from pubis; double fracture of pubis with piece of bone perforating bladder.

Case 9. Walker, Communications Mass. Med. Soc., 1845, vii. A male, aged 23, sustained a fracture of the right pubis and separation of left sacro-iliac synchondrosis in a railroad wreck. Later, perineal cystotomy; catheter obtained only a few ounces of urine. Immediate improvement. He went to work 55 days later.

Case 10. Watson, Month. J. Med. Sc., 1848. A man of 33 was "run over;" he was unable to urinate; catheter obtained bloody urine; tumefaction; incision over perineal and scrotal swelling. He died after 8 days. Autopsy: rupture in neck of bladder; extensive pelvic fracture; infiltration of blood and urine.

Case 11. Thouvenet, Bull. Soc. anat. de Par., 1849, xxiv. Male patient of 27, injured in a fall. He died in 48 hours. Autopsy: anterior rupture of bladder; urine in pelvis; injury to pelvic bone.

Case 12. Keate, in Hewett, Lond. Med. Gaz., 1850. A man was "run over" and sustained a separation of the symphysis pubis; bloody urine by catheterization. He died after 4 days. Autopsy: pelvic fracture; prostate torn from bladder; urine infiltration.

Case 13. Lente, N. Y. M. J., 1850, iv, 286. Male, aged 18, was crushed under a car. Hot applications were applied over the distended bladder; urine was passed the second day. He died after 2 days. Autopsy: non-urinous fluid in peritoneal cavity; laceration of bladder fundus; separation of symphysis pubis.

Case 14. Peaslee, Am. J. M. Sc., 1850, xix. A male 30 years old was crushed by a train. Fæces and urine escaped through perineal wound. He died after 41 days. Autopsy: severe fracture of pelvis; large extraperitoneal pus cavity.

Case 15. Hewett, Lancet, Lond., 1850, i, 573. Male aged 50. A man jumped on him. Bloody urine by catheterization; later there were fluctuating tumors above pubes, etc. Operation on twelfth day; incision over left iliac region, 3 pints of pus evacuated, urine through incision. Patient died in 23 days. Autopsy: pus in prevesical space; rupture in anterior wall of bladder opening into pus cavity; fracture in pelvis.

Case 16. Hewett, Lancet, Lond., 1850, i, 573. A boy of 12 was injured by having a heavy weight fall on him. Bloody urine by catheterization. He died the sixth day. Autopsy: two ruptures in anterior wall of bladder; extravasation into pelvis, etc.; extensive fracture of pelvis; blood in peritoneal cavity.

Case 17. Hewett, Lancet, Lond., 1850, i, 573. Male, aged 50, injured in an accident and died 22 hours later. Autopsy: rupture in left side of bladder leading into subperitoneal cellular tissue; extensive effusion of bloody fluid.

Case 18. Hewett, Lancet, Lond., 1850, i, 573. A man, aged 38, was injured in an accident and died 5 days later. Autopsy: rupture in neck of bladder; urine infiltration; extensive pelvic fractures.

Case 19. Hewett, Lancet, Lond., 1850, i, 573.

Male, aged 32, was "run over." Bloody urine by catheterization. He died the fourth day. Autopsy: rupture in right side leading into small cavity in cellular tissue; infiltration; laceration of symphysis pubis.

Case 20. Hewett, Lancet, Lond., 1850, i, 573. Patient, a man of 32 years, was crushed by a falling timber. Upon catheterization no urine was obtained; tumefaction of abdomen, etc.; free urine escaped after incision of urethra and swollen parts. Patient died the fourth day. Autopsy: fracture of pelvis; rupture of bladder behind symphysis communicating with cavity containing pus, etc.

Case 21. Hewett, Lancet, Lond., 1850, i, 573. Patient, male, aged 34, fell from a height and died in 2 hours. Autopsy: rupture of bladder behind pubes; separation of symphysis pubis and fracture of pelvis.

Case 22. Warren, Am. J. M. Sc., 1851, xxii. A man of 30 was crushed by a fall of earth and died on the way to the hospital. Autopsy: peritoneal cavity filled with blood; rupture of bladder posterior to symphysis; fracture near symphysis through ilium, etc.

Case 23. Currie, Med. Press & Circ., 1853, ii. 465. A male, aged 22, was caught under a cart and sustained a pelvic fracture. Operation after 2 weeks, incision 1½ inches between tuber ischii and anus, evacuation of purulent urine; retention catheter. Patient recovered in 4 months.

Case 24. Varren (1854), in Lesur, Thesis de doct., Par., 1888. A man of 30 was crushed and died in an hour. Autopsy: rupture of bladder behind symphysis pubis; separation of symphysis; fracture of pelvis.

Case 25. Stanley, Brit. M. J., 1857. A boy of 8 was injured by a gate falling on him and died on the sixth day. Autopsy: fracture of right pubis; separation of sacro-iliac synchondrosis; four ruptures in bladder, etc.

Case 26. Dubreuilh, Bull. Soc. Anat. de Par., 1867, p. 7. Patient, a male, sustained an accident producing luxation of all pelvic articulations, pelvic fracture and other extensive injuries including rupture of bladder. Treatment, etc., not mentioned. Patient died.

Case 27. Croly, Dublin Med. Press & Circ., 1859, xli. A man of 66 was "run over." He was catheterized (clear urine) but had no inclination to urinate. Patient died the second day. Autopsy: fracture of right pubis; rupture of bladder anteriorly; urinary infiltration.

Case 28. Faure, Bull. Soc. anat. de Par., 1863, xxxviii. Patient, a male, was injured in an accident and died in 4 days. Autopsy: numerous pelvic fractures; transverse rupture of bladder in posterior wall.

Case 29. Shoemaker, Nederl. Tijdschr. v. Geneesk., 1862. Male, aged 21, was injured in a fall. Retention of urine, blood by catheterization. He died after 14 days. Autopsy: separation of symphysis and fracture of pubis.

Case 30. Harrison, Dublin M. J., 1869, ix. A boy, of two years six months, was "run over." He had voluntary urination; developed erysipelas the fourth day and died the tenth day. Autopsy: rupture of anterior wall of bladder; separation of symphysis and fracture of pubis.

Case 31. Truefford, Union méd., Par., 1864, xxiii. A man of 50 was crushed by a fall of bricks; he had a tumor in the right thigh almost to knee, non-fluctuant; catheter drew blood and urine; retention catheter. Tumor fluctuated the thirteenth day and incision was made over it; evacuation of blood, urine, pus, etc. Fracture very possible. Wound in base of bladder and one on the right side healed in 30 days. Recovery.

Case 32. Rose, Charité-Ann., Berl., 1865, xiii. Male, aged 25, fell from a tree. He bled from the urethra and catheter proved useless; after 2 days urine and blood were passed spontaneously and in 2½ months a urinary fistula developed. Urethrotomy performed after 14 months. Patient died. Autopsy: united fracture of pubis; catheter found in cavity between bladder and rectum.

Case 33. Fleming, Dublin Q. J. M. Sc., 1866, xliii. A man of 60 was injured by a wall falling on him. Bleeding through urethra; he died in 48 hours. Autopsy: rupture of bladder anteriorly; separation of symphysis and fracture of sacrum.

Case 34. Symes, Dublin Med. Press & Circ., 1866, i, 278. A man, aged 45, was injured in a fall. When seen 8 days later he had retention of urine; upon catheterization blood, urine, and pus were obtained; tumor over hypogastrium. He died the twelfth day. Autopsy: two ruptures in anterior wall of bladder; separation of symphysis; peritonitis.

Case 35. Shaw, Lancet, Lond., 1867, i, 174. A man of 50 fell while drunk. Blood and urine by catheterization; there was a tumor in hypogastrium and iliac region; later voluntary bloody urine. Patient died the fifth day. Autopsy: both pubic bones were fractured, the left pubic perforating the bladder twice; urinary infiltration.

Case 36. Williams, Am. J. M. Sc., 1867, liii, 446. A woman, aged 53, was "run over." Bloody urine obtained by catheterization. She died in 48 hours. Autopsy: rupture of bladder by a piece of fractured ischium.

Case 37. Burlington, Am. J. M. Sc., 1868, lv. Male, aged 25, injured in a fall. He could not urinate; there was a rupture in the neck of bladder and a compound fracture of the sacrum, urine escaping through wound. Abscesses developed. He was in bed for more than a year suffering from extensive suppuration. Patient lived two years continually suffering.

Case 38. Grant, Austral. M. J., 1868, xiii. Male, aged 53, fell from a horse. Catheterization showed blood in bladder. He died in 26 days. Autopsy: blood in peritoneal cavity; separation of symphysis with rupture of bladder behind.

Case 39. Seelye, Am. J. M. Sc., 1868, lv. A man, aged 32, was crushed by a heavy man. Blood by catheterization. He died the fourth day. Autopsy: separation of symphysis; rupture in anterior part of fundus; infiltration.

Case 40. Logan, New Orleans J. Med., 1870, xxiii, 114. Male, aged 43, jumped from a second story. Blood obtained by catheterization. He died. Autopsy: fracture of sacrum; separation of symphysis pubis; rupture of bladder beneath perineum.

Case 41. Clark (1872), in Bartels, Arch. f. klin. Chir., 1878, xxii. A man, aged, 20, was crushed. Perineal section made the third day, blood and urine coming from wound; he died the twenty-fifth day. Autopsy: rupture of bladder; fracture of pubis and ischium.

Case 42. Gross, System of Surgery, Philadelphia, 1872. Patient, a young man, was injured in a fall. He was unable to urinate and there was infiltration of urine into perineum, etc. He died from peritonitis and gangrene 2 weeks after the injury. Autopsy: rupture of bladder; fracture of ischium and pubis.

Case 43. Smith, Dublin J., 1872, liii, 53. A female, aged 60, was "run over," had retention; blood obtained by catheter; tumor in iliac region. She died the fourteenth day. Autopsy: laceration at neck of bladder; fracture of ischium and both pubes.

Case 44. Duetsch, in Bartels, Dublin J., 1872, liii. A man of 20 was crushed between cars. Anuria, peritonitis; he died in 48 hours. Autopsy: rupture of bladder; separation of symphysis, deep depression of left pubic bone.

Case 45. Dickenson and Holmes, St. George's Hosp. Reports, Lond., 1874, viii. A man aged 42,, was injured

in a fall; he fractured the ilium, ruptured the bladder, anuria following. Perineal section made; patient died in 43 days. Autopsy: rupture of bladder with fracture.

Case 46. Jenden, Deutsche Ztschr. f. Chir., 1874, iv. A male, aged 35, was injured in a fall after which there was extensive suppuration in the bladder region; he was operated on on the twentieth day through the right inguinal canal through which blood and urine were evacuated. Patient died in 6 months. Autopsy: fracture of pubis and perforation of bladder.

Case 47. Rudell, Austral. M. J., 1874, xix. A male, aged 56, injured by having a horse fall on him, died after 2 days. Autopsy: separation of symphysis; transverse rent in anterior wall of bladder.

Case 48. Teissier, Lyon méd., 1875, xix, 440. Male, aged 25, was crushed under a heavy mass. Blood and urine by catheterization. He died the third day. Autopsy: six fractures; 3 of pubis corresponding to 3 ruptures of bladder, bones perforating.

Case 49. Barth, Bull. Soc. anat. de Par., 1876, li. A man of 25 was "run over." Blood and urine by catheterization. Patient died the second day. Autopsy: extravasation of blood and urine subperitoneally; separation of symphysis pubis; fracture of sacrum and pubis; perforation of bladder.

Case 50. Fleming, Clinical Record of the Injuries and Diseases of the Genito-Urinary Organs, Dublin, 1877. Patient, a man of 43, injured in a fall. He was taken to the hospital after one week; anuria, tumor in hypogastrium. He died in 12 days. Autopsy: cavity behind abdominal muscles filled with blood, urine, etc., contracted bladder behind this; fracture of sacrum, separation of symphysis pubis.

Case 51. Fleming, Clinical Record of the Injuries and Diseases of the Genito-Urinary Organs. Dublin: 1877. A boy of 7 was "run over;" shock and collapse; retention catheter. He died after 8 days. Autopsy: fracture of both pubes with penetration of bladder.

Case 52. Heath, Lancet, Lond., 1877, i, No. 19. A man of 40 injured by an engine bed falling on him; shock, scrotal swelling, etc.; bloody urine by catheterization. He died after 26 hours. Autopsy: subperitoneal infiltration; tear in anterior wall of bladder; separation of symphysis pubis and sacro-iliac synchondrosis.

Case 53. McDougall, Edinb. M. J., 1877, Jan. Patient, a man, was run over while drunk. Blood by catheterization; symptoms of peritonitis, tumor over pubis, fracture of ilium demonstrated; treated by retained catheter, followed by recovery.

Case 54. Augur, in Chaboureau's Thesis de doct., Par., 1878. A man was "run over" and died in a few hours. Autopsy: multiple fractures; extraperitoneal rupture of bladder.

Case 55. Bartels, Arch. f. klin. Chir., 1878, xxii. A man of 50 was injured by a horse falling on him. Examination showed fracture of pubes, bloody urine by catheter, anuria; extravasation relieved on tenth day by incisions. Slow recovery; began using crutches after 9 months, able to walk after 15 months; alive 6 years later, but suffering from fistula, etc.

Case 56. Chaboureau, Thesis de doct., Par., 1878. A man of 24 was "run over" and died after 4 days. Autopsy: multiple fractures; rupture in anterior wall of bladder.

Case 57. Chaboureau, Thesis de doct., Par., 1878. A boy of 14 was "run over." Perineal incisions made for infiltration. He died in 6 days. Autopsy: fracture of pelvis with extra-peritoneal rupture of bladder.

Case 58. Chaboureau, Thesis de doct., Par., 1878. A man was "run over" and died in 24 hours. Autopsy: separation of symphysis pubis; rupture of bladder posteriorly.

Case 59. Demme, in Bartel's Thesis de doct., Par., 1878. A man of 27 was injured by a tree falling on him. He was unable to urinate; ecchymosis over groin; catheter drew a few drops of bloody urine only; incision on third day; he died the sixth day. Autopsy: fracture of pubis with a fragment perforating the bladder.

Case 60. Giralt, Hosp. Gaz., N. Y., 1878, iv. Male, aged 31, was struck by car. Retention of urine, bloody urine by catheterization; perineal incision and evacuation after 24 hours. He died in 28 days. Autopsy: fracture of both pubes; rupture of anterior wall of bladder.

Case 61. Guenzburg, Hosp. Gaz., N. Y., 1878, iv. Man of 45 was struck by a beam; he was unable to urinate and died in 60 hours. Autopsy: rupture of bladder near symphysis; fracture of ilium and pubis.

Case 62. Louis, in Bartholemy, Franc. méd., Par., 1878, xxv, 813. Man of 53 was injured in an accident and died after 7 days. Autopsy: peritonitis; rupture of anterior wall of bladder; fracture of pubis, bone fragment penetrating bladder.

Case 63. Nelaton, in Chaboureau, Franc. méd., 1878, xxv, 813. A woman was "run over" and sustained a fracture of the pubis with a piece penetrating bladder and vagina; fragment removed through vagina. She recovered.

Case 64. Renaud, in Bartholemy, Franc. méd, 1878, xxv, 813. A man of 24 was injured in a fall and died in 4 days. Autopsy: quadruple fracture with piece of pubis penetrating bladder.

Case 65. Savard, Bull. Soc. anat. de Par., 1878, liii. A man of 36 was "run over" and died in 3 days. Autopsy: double fracture in pelvis and double rupture of bladder.

Case 66. Vinout from Chaboureau. Man, aged 32, was injured in a fall and died in 4 days from separation of symphysis pubis and extraperitoneal rupture of bladder.

Case 67. Voillemier from Chaboureau. A male, aged 24, injured in an accident, a weight falling on his abdomen. Ruptured bladder, fracture of pubis with separation of sacro-iliac synchondrosis. He died in 5 days.

Case 68. Morris, Lancet, Lond., 1883, ii. A boy of 15 was "run over." Blood by catheterization; iliac swelling; median incision after 10 hours showed blood in peritoneum; no rupture found. Patient died after 24 hours. Autopsy: fracture of both pubic bones; rupture in anterior wall of bladder.

Case 69. Rivington, Lancet, Lond., 1882, lxxvii and lxxviii. A man of 24 was injured in a fall. Blood and urine by catheterization; scrotal swelling. He died in 4 days. Autopsy: fracture of ischium and pubis; neck of bladder ruptured.

Case 70. Stone, Med. News, Phila., 1883, xliii, 484. Male, aged 21, crushed between cars sustained a laceration into peritoneal cavity through which urine escaped; no urine by catheterization; retention catheter applied. He died on thirty-fifth day. Autopsy: separation of symphysis; rupture through base and neck of bladder.

Case 71. Alexander, Liverpool Med.-Chir., J., 1884, iv, 176. Male, aged 41, was "run over." Bloody urine by catheterization; abdominal section made in 36 hours revealed rent in bladder by spicule of bone. He died the second day. Autopsy: fracture of pubis; fracture of sacrum; laceration of bladder.

Case 72. Cohn, Bull. Soc. anat. de Par., lix, p. 146. A man of 56 was "run over." Anuria; bloody urine by catheterization. He died in 65 hours. Autopsy: no infiltration of urine; double fracture of sacrum; bladder perforated behind symphysis by rupture of ligament.

Case 73. Harrison, Liverpool Med.-Clin. J., 1884, iv. A man of 29 fell with a big stone on top of him. Blood and urine by catheterization; median perineal incision

made in 24 hours; drainage established after exploration of bladder. Patient died the seventh day. Autopsy: pelvis fractured in 6 places; laceration of bladder in anterior wall and trigone.

CASE 74. Willard, Maryland M. J., 1885, xiii. A male, aged 23, was crushed under an engine. Anuria; blood and urine by catheterization. Patient died in 3 days. Autopsy: separation of symphysis, left pubis penetrating bladder; fracture of ischium, etc.

CASE 75. Schrady, Med. Rec., N. Y., 1886, xxx, 441. A man was caught between wheels. Extravasation of urine; operation in 24 hours, suprapubic cystotomy, drainage established. He died the fifth day. Autopsy: rupture of bladder, urethra torn across; multiple fractures of pubes and ischium, etc.

CASE 76. Hofmokl, Wien. med. Presse, 1886, xxvii, 1227. Male, aged 27, fell from a height and sustained a double rupture (intra and extraperitoneal) of the bladder with disjunction of symphysis pubis and open fracture of right pubis. Laparotomy was performed 12 hours later; blood and urine found in prevesical cavity; intraperitoneal rupture of fundus of bladder sutured, extraperitoneal rupture of bladder left open and drained and a retention catheter left. Patient recovered slowly.

CASE 77. Briddon, N. Y. M. J., 1887, xlv. Male, aged 33, was injured by a stone falling on him. Bloody urine by catheterization; laparotomy in four and one-half hours, permanent catheter inserted and drainage established. There was a double fracture of pubes; rupture of anterior wall of bladder; catheter removed the eleventh day. Patient recovered; fistula present 7 months later.

CASE 78. Briddon, N. Y. M. J., 1887, xlv. Male, aged 42, was struck by a locomotive. Bloody urine per catheter; perineal incision 6 hours later, tube left in bladder; suprapubic incision and drainage. There was a fracture of pubis with rupture of anterior wall of bladder. Patient died the sixth day. No autopsy.

CASE 79. Mason, Lancet, Lond., 1887, i, 172. A man, aged 36, was crushed by a wagon. Bloody urine by catheterization. Incision over pubis, retention catheter applied. Patient died the seventeenth day. Autopsy: fracture of pubes, right pubis pushed into bladder.

CASE 80. Robson, Brit. M. J., i. Male, aged 68, was operated on for ruptured bladder but died a few hours later. Autopsy showed perforation of anterior wall of bladder by bone fragment from comminuted fracture of pubis.

CASE 81. De Arx in Cor.-Bl. f. schweiz. Aerzte, 1888. A male sustained a fracture of pubis in an accident. Laparotomy performed and bladder found ruptured and was drained by retention catheter. Patient died after 34 hours. Autopsy showed bladder to be torn by fractured pubis; extraperitoneal hæmorrhage.

CASE 82. Bond, Lancet, Lond., 1889, Aug. 10. A man, aged 34, was crushed by a heavy mass. Laparotomy and exploration of bladder the third day. Patient died. Autopsy: bladder lacerated at neck; fracture of ischium.

CASE 83. DeMolliere, Lyon méd., 1889, March. A man was injured in a fall. Fracture of both pubes with fragment penetrating bladder near the base; extravasation also into peritoneal cavity; operation in 24 hours through perineum; retention catheter. Recovery.

CASE 84. Rose, Deutsche Ztschr. f. Chir., 1891, xxxi, 347. A male, aged 32, injured in a fall. Suprapubic operation after 48 hours; rupture in anterior wall of bladder; fracture of sacrum and pubes. Suprapubic drainage, no sutures, continuous bath. Recovery in 6 months.

CASE 85. Imbriaco, Gior. med. d. r. esercito, etc., Rome, 1892, xl, 1441. A man accidently injured suffered an extraperitoneal laceration of the bladder together with fracture of pubis, and died in 7 days.

CASE 86. Arnheim, Deutsche med. Wchnschr., 1893, xix, 418. Female, aged 41, operated after a pelvic injury found to have a double extraperitoneal rupture of the bladder caused by penetrating pelvic bone fragments. Suprapubic operation with suture of bladder wound. She died the twentieth day.

CASE 87. Arnheim, Pest. med.-chir. Presse, Budapest, 1893, xxix, 267. A man hurt in a fall had a laceration of the bladder and separation of symphysis pubis. Operation in the eleventh day, wiring of symphysis, permanent catheter. Result: extrusion of sequestra but recovery in 4 months.

CASE 88. Parker, Society of Clinics of London, 1893, Jan. 27. A boy 9 years old struck by a car sustained a [illegible]ure of the femur, separation of symphysis pubis and [illegible]re of the bladder. Operation: suprapubic incision [illegible] drainage. Recovery.

CASE 89. Beckman, Thesis de doct., Halle, 1896. A man of 42, after a pelvic injury, was found to have an extraperitoneal rupture of the bladder with fracture of pelvis. Operation: sectio alta with suture of bladder wound, retention catheter. Recovery in 3 months.

CASE 90. Cushing in Mitchell, Ann. Surg., Phila., 1898, xxvii, 175. A man of 33 was crushed by heavy weight. He was operated on after 36 hours; suprapubic cystotomy, retention catheter. He died the fourth day. Autopsy: multiple fractures, perforation in anterior wall of bladder.

CASE 91. Van Moorsel, Nederl. mie geneesk. Arch., 1896, xx, 331. Case of a man "run over." Operation showed extraperitoneal rupture of bladder with separation of symphysis and fracture of pubis. Suprapubic incision, retention catheter. Patient died in 24 hours.

CASE 92. Wiessinger, Festschr. z. Feier d. 8 Jahr. f. d. Aerzte. Verein zu Hamburg, 1896. Patient, a man of 26, was injured by a heavy mass falling on him and operated 12 hours later; he was again operated the 17th day; fracture of pubis with extraperitoneal rupture of bladder. He was discharged as cured in 3 months.

CASE 93. Schwizer, Dissertation, Muenchen, 1894. A man of 59 was crushed by a locomotive and sustained a fracture of pubes; blood obtained by catheterization; hypogastric incision made and drainage established; retention catheter. He died the second day. Autopsy: fracture of both pubes, bone fragment penetrating bladder; diastasis of left sacro-iliac symphysis.

CASE 94. Mauclaire, Bull. Soc. anat. de Par., 1897, p. 860. A man was crushed by a heavy block of stone. Symptoms of peritonitis; laparotomy; perforation of bowel, rupture of anterior wall of bladder, fracture of ilium and pubis. He died 12 hours after operation.

CASE 95. Mitchell, Ann. Surg., Phila., 1898, xxvii, 151. A woman, aged 52, fell from a wagon and was crushed under wheel. Operated on 17 hours later; fracture of left pubis and extraperitoneal rupture of bladder; bladder wound sutured; patient kept in continuous bath for 40 days. Fully recovered in 9 months.

CASE 96. McLaren (1896 case), J. Am. M. Ass., 1898, xxx, 1328. A man crushed by a fall of bricks sustained a fracture of the left pubis; bloody urine by catheterization; tumefaction of scrotum, etc. Operation, inguinal and perineal incision; later secondary lumbar abscess treated for 2 years. Recovery.

CASE 97. Biss, Bull. Soc. anat., de Par., 1899, p. 956. A man fell from a height on the right side against a heavy object, sustained multiple fractures of the pelvis, and died after 18 hours. Autopsy: rupture of anterosuperior wall of bladder caused by bone fragment; fracture of pubis, sacrum, etc.

CASE 98. Loheac, Bull. Soc. anat.-clin. de Lille, 1899, p. 733; cited by Jonon. Male, aged 43, was injured in

a fall. Operation, suprapubic cystotomy, no bladder rupture could be found. He died in 3 days. Autopsy: three ruptures in bladder; fracture of the two pubic bones, etc.

CASE 99. Roedmann, Thesis de doct., Leipzig, 1900. A boy of 10 was injured by a heavy weight falling on his abdomen; abdominal tumefaction in 12 hours; fracture of right pubis; catheterization showed bloody urine. Operation: bladder ruptured near neck; sutured; retention catheter. Rapid recovery.

CASE 100. Roedmann, Thesis de doct., Leipzig, 1900. A boy of 15 fell from a height on to a hard substance and sustained multiple fractures including a fracture of the pelvis. He died shortly after the accident. Autopsy: extraperitoneal rupture of anterior wall of bladder.

CASE 101. Roedmann, Thesis de doct., Leipzig, 1900. Male, aged 40, while drunk, was crushed between a wall and a wagon. A fracture of the pelvis was evident and no urine was obtained per catheter. He died the same evening. Autopsy: separation of symphysis pubis; blood in peritoneal cavity; rupture of anterior wall of bladder.

CASE 102. Mailland, Lyon méd., 1901, xcvi, 720. Male, aged 68, injured in a fall; operated on next day but died on the following day. Autopsy showed six pelvic fractures, bladder perforated at base by piece of bone.

CASE 103. Jonon, Ann. d. mal. d. org. genito-urin., 1902, xx, 1071. A man, aged 25, was crushed by a car and sustained a pelvic fracture. Blood and urine by catheterization; retention catheter for 5 days after which operation was made. Rupture of bladder found extraperitoneally which was due to a bone fragment. He died 50 days after the accident. Autopsy: fracture of both pubes in addition to bladder perforation.

CASE 104. Bazy, Bull. Soc. de chir., Par., 1902, Mar. 20. A man was injured in a fall from a horse and sustained a double fracture of the pelvis and rupture of the bladder. Hypogastric and perineal incision made. Patient died.

CASE 105. Astuse, Thesis de doct., Montpellier, 1895. Male, aged 18, sustained a fracture of pubis and extraperitoneal rupture of bladder from a gunshot wound. No urine obtained by catheterization; suprapubic incision made the next day and three particles of bone removed from torn bladder; no sutures; drainage and retention catheter. In 2 months patient recovered without fistula.

CASE 106. Eastman, N. Y. M. J., 1905, lxxxii, 795. A man of 50 years was injured by a weight falling upon him; pubic arch was driven in on right side, blood and urine per catheter. Suprapubic incision made, spicule of bone of ramus of pubis penetrating anterior wall of bladder; fracture adjusted, bladder drained and tamponed. Recovery.

CASE 107. Eastman, N. Y. M. J., 1905, lxxxii, 795. Male injured in a railroad wreck; bladder and rectum impaled by sharp instrument; fracture of ilium; fracture of femur; rectal and bladder wounds sutured; retention catheter. Natura urination after 10 days. Recovery.

CASE 108. Eastman, N. Y. M. J., 1905, lxxxii, 795. A man crushed under a heavy mass sustained a fracture of pelvis with rupture of bladder, pubic arch driven in, anterior wall of bladder and roof of prostatic urethra torn; bladder not sutured but urethral and suprapubic drainage; bone reduced. Recovery.

CASE 109. Morel, Ann. d. mal. d. org. genito-urin., 1906, xxiv, 801. Male, aged 24, received a crushing injury. Blood per catheter; operation next day; anterior wall of bladder ruptured by bone fragment from iliopubic fracture; suprapubic drainage. Patient died after operation.

CASE 110. Marnoch, Ann. Surg., Phila., 1906, xliii, 241. A woman of 41 fell 10 feet striking side of pelvis. Fracture of pelvis demonstrated by palpation; operation after 41 hours; extraperitoneal rupture of bladder which was sutured and retention catheter introduced. Recovered and left hospital in 4 months.

CASE 111. Espey, Colo. Med., 1907, iv, 190. Male of 21 was injured by an iron bar falling on him. No fracture demonstrated on examination; blood and urine by catheter; peritonitis, death in 3 days. Autopsy: fracture of right pubic bone, fragment penetrating bladder both intra and extraperitoneally.

CASE 112. Besley, Surg., Gynec. & Obst., 1907, iv, 514 (case 5). A man of 29 was crushed between two cars. Operated on next day; fracture ramus of pubis, bladder perforated. Patient died.

CASE 113. Besley, Surg., Gynec. & Obst., 1907, iv, 514 (case 10). Male, aged 23, crushed between car and wall. Operation a few hours later showed fracture of pubic ramus penetrating bladder intraperitoneally; drainage both supra- and infrapubic. Recovery.

CASE 114. Besley, Surg., Gynec. & Obst., 1907, iv, 514 (case 11). A man of 25 was crushed between 2 cars. Operation disclosed horizontal posterior rent in bladder by penetration of bone fragment from fracture of pelvis; suprapubic drainage. Patient died.

CASE 115. Besley, Surg., Gynec. & Obst., 1907, iv, 514 (case 12). Male, aged 35, was struck by a locomotive. Operation showed fracture of pubic ramus lacerating the bladder intraperitoneally; bladder and peritoneal drainage. Patient died.

CASE 116. Besley, Surg., Gynec. & Obst., 1907, iv, 514 (case 18). A woman, aged 38, fell from a window while intoxicated. Palpation demonstrated pelvic fracture; bloody urine by catheter. Operation showed rupture in posterior wall of bladder; sutured; drainage through urethra. Patient died.

CASE 117. Roughton, Clin. J., Lond., 1909, xxxiv, 63. A male, aged 21, was "run over." Pelvic fracture obvious; bloody urine per catheter. Operation showed intraperitoneal rupture of bladder, fracture palpated at right iliopectineal eminence, bladder sutured without drainage, catheterization every 4 hours, but fistula developed and healed in 2 months. Recovery.

CASE 118. Roughton, Clin. J., Lond., 1909, xxxiv, 63 (case 2). Male, aged 44, crushed between two busses. Operation showed comminuted pelvic fracture, rent in bladder near left side of trigone; suture and drainage, good recovery.

CASE 119. Roughton, Clin. J., Lond., 1909, xxxiv, 63 (case 3). Boy of 17 crushed between 2 cars. Suprapubic operation showed fracture of left pubic ramus with fragment penetrating bladder; bladder tear not sutured, suprapubic drainage. Good recovery.

CASE 120. Fenwick, Brit. M. J., 1910, April 2, 798, A man of 56 was thrown from a carriage. Treated only by catheter for 20 days when operation showed urinary extravasation and fracture of horizontal ramus of pubis. He died on the thirtieth day. Autopsy verified the pelvic fracture and showed an extraperitoneal bladder rupture.

CASE 121. Gayet, Lyon méd., 1911, cxvii, 778. A boy of 14 fell from a height and sustained a double pelvic fracture as shown by radiograph; urine bloody; retention catheter. Operation the same day showed a small linear tear in posterior wall of bladder, this was sutured; suprapubic drainage. Recovery.

CASE 122. Slocker, Riv. de med. chir. Prat., 1911, xxxv, 249. A man 55 years old, kicked by a mule, had bloody urine by catheterization. Suprapubic operation: bony splinter from pubis found to have penetrated bladder on its peritoneal surface, bone removed, bladder sutured and drained. Recovery.

CASE 123. Slocker, Riv. de med. chir. Prat., 1911, xxxv, 249. Man operated on for gunshot wound of pubis; fragment of bone found to have been detached and penetrated bladder laterally; bladder wound not sutured, but drained. Patient died.

CASE 124. Naumann, Nord. med. Ark., Stockholm, 1912, xlv, No. 1. Boy of 17 crushed by railway car. Operation showed fracture of pelvis and tear in bladder; drainage of bladder and peritoneal cavity. Patient recovered, fistula healed after 3½ months.

CASE 125. Fuller, J. Am. M. Ass., 1914, lxiii, 2114. Male, aged 23, pelvis crushed between cars. Perineal infiltration and incision. After 2 months X-ray showed pelvic fracture. Operation demonstrated bladder rupture extraperitoneal. Patient recovered slowly.

CASE 126. Blackburn and Cook, Lancet, Lond., 1915, ii, 1132. Man of 45 years on suddenly jumping on a horse felt severe pain and fell to the ground; bloody urine per catheter; operated 6 hours later; ramus of left pubic bone fractured, bladder torn in prostatic region; bladder packed and drained. Recovery, fistula healed in 3 months.

PELVIC VARICOCELE

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AS the Chilean literature on the subject of pelvic varicocele is scarce, I thought it might be of some interest to report, with a few comments, the clinical histories of the cases I have observed.

There are two varieties of ovarian varicocele; primary and secondary. The former is not associated with other genital diseases while the latter is the result of a growth or of a pathological process in the pelvic organs, the ovary, uterus, or broad ligament.

A condition of paramount importance in all varicose diseases, such as hæmorrhoids, varices, etc., is chronic inflammation of the vein-wall, the starting point of stasis; therefore, a microscopic examination is necessary before varicocele can be definitely diagnosed, as it sometimes happens that instead of varicocele we have simply a venous dilatation. It is well known that during pregnancy the tubo-ovarian veins reach an enormous size, a fact which I had the opportunity of proving to my satisfaction in a patient upon whom I operated in September, 1914, for a carcinoma of the uterus. The operation was performed during puerperal involution, and we were considerably handicapped in the Wertheim panhysterectomy because of the enormous size of the vessels of the uterus and broad ligament.

The same anatomical grounds in the male explain the greater frequency of varicocele on the left side; the position of the spermatic vessels behind the ileopelvic colon and the anastomosis to the renal vein should be considered, especially the first factor when aggravated by chronic intestinal stasis so common among such patients. These mechanical elements are not, however, pathogenic; we have to take into consideration the condition of chronic inflammation of the fibrous tissue, which English authors call fibrosis or fibrositis and which is usually produced by a slight infection (Adami).

It is not unusual for these women to present a persistent œdema of the ovary and sometimes of the uterus, such as the elephantiasis of a varicose leg or the enlargement of a testicle below a varicocele. After a variable length of time this engorgement may end in sclerosis and finally in atrophy.

A number of gynecologists call attention to the relation between varicocele and fibrocystic ovaritis. It is interesting to note the peculiar softness of the ovary and uterus when we are fortunate enough to treat the disease in a very early state before the fibrotic processes have taken place and gained some ground. The uterus is very soft, like an old cloth, and its walls are compressible. Such characteristics are not found in other conditions which are accompanied by uterine swelling with perhaps the single exception of a uterus shortly after a miscarriage.

The symptoms are very unusual. The patients, often multipara, complain of pain in the lumbar region and in the lowest parts of the abdomen. The pains are aggravated

when the patient stands and during or near the menstrual period, and they subside when the patient lies down or when the flow has started. As the physical signs are very poor and often quite negative, these poor patients are relegated to the large group of so-called neurotics. The menses are abundant and irregular as to duration and date of beginning. Another symptom often mentioned in the clinical histories of pelvic varicocele, is the watery leucorrhœa which is very difficult and tedious to treat, and, like the other symptoms, is greatly aggravated during menstrual periods.

The physical examination is very often negative, but in favorable cases we feel a hard lump situated below the ovary, which is almost always swollen and flaccid, at the bottom of the pouch of Douglas. When standing the palpation will be more positive and when suspected we must have recourse to examination in this position.

The co-existence of varicose veins in the lower legs and labia will be of assistance in the differential diagnosis.

The diagnosis after all we have said may be considered difficult and usually made by exclusion as is the case in all diseases which are accompanied by a few physical signs.

If a patient complains of pains which are made more severe by standing or walking and which are ameliorated when lying down, if these pains increase when the menstrual flow approaches, and when the menses are very profuse, then we have sufficient reason to suspect a varicocele, more especially when palpation reveals a soft mass, quite independent of the ovary and tube. If the perineum is flail, not resistant, and at the same time varices and a bluish color are to be seen on the collum uteri and vagina, the diagnosis is fairly safe.

Chronic appendicitis is the commonest error made in diagnosing these cases. Some of these patients are subjected to appendectomy with of course negative results. Chronic metritis is the next most common error. This is very easy to explain if we remember that leucorrhœa and an increase in the size of the uterus are two of the most frequent symptoms of chronic metritis. Œdema due to venous stasis and the transudation of lymph is the cause of these conditions. The leucorrhœa is very peculiar in these cases and if we ask the patients more closely regarding it, they always state that the fluid is watery, like urine, quite different from the yellow discharge in cases of metritis.

Some surgeons are of the opinion that fibrocystic ovaritis is often the result of pelvic varicocele; others deny any relationship between these two diseases. Without entering into a discussion on this point, I think the practical conclusion to be drawn therefrom is that once we have made the first diagnosis we are in no way authorized to deny the existence of the latter but on the contrary our duty in such a case is to investigate it.

With these incomplete comments and before going into particulars as to treatment, let us briefly summarize the complications or anomalous symptoms.

There are in the medical literature some cases of retro-uterine hæmatocele and ovarian hæmorrhage which possibly may be attributed to rupture of a varicose vein. The bursting and bleeding may take place between the layers of the broad ligament, thus giving rise to a hæmatoma the result of which is ultimately and usually a fibrous new-growth, a kind of fibroma.

In October, 1914, I operated on a woman suffering from a uterine cancer and as I found in the vicinity of the uterus a lump the size of a hazelnut I feared it might be of the same nature and the operation useless. The tumor was situated below the right ovary and its surface gave the appearance of worms. The pathologist's report says: fibroma. Unfortunately, there were no further details.

As during pregnancy the varicose veins undergo a greater development it is not unlikely that profuse hæmorrhages may supervene, and the treatment of this condition is sometimes very difficult. At the annual meeting of the American Medical Association held at Atlantic City, in 1914, Zinke of Cincinnati gave the history of a woman, 35 years old, six weeks pregnant, who consulted him because of profuse hæmorrhage. He curetted her. The bleeding, however, continued during five

months, at the end of which time and knowing that she was again pregnant, he resorted to laparotomy. He found a soft mass which he believed to be para-ovarian and which he removed. The patient recovered, her pregnancy following uninterruptedly its normal course.

The treatment should only be surgical if we aim to obtain a permanent cure. Medically we can relieve the condition of such patients if we advise the recumbent position and the correction of pelvic organs by means of a vaginal plug or a reconstructive perineal operation.

CASE 1. R. G., age 28; III-para; two miscarriages, the last one a year before. Since then menstruations were very profuse and painful. She complains of pains in both loins and deeply in the hypogastrium. She feels a tiresome sensation. At the beginning of June, the pains became more marked and she vomited several times. She had an abundant serous leucorrhœa which she could differentiate from that of some of her relatives who suffered from chronic metritis. The portio vaginalis was enlarged, the copus voluminous and soft. Behind and to the left in the deepest part of Douglas' pouch, a round, even, and soft mass is easily palpable and tender to pressure. It was believed by myself and other examining physicians to be a sclerocystic ovary.

Median laparotomy, June 26, 1916. The left ovary was soft, enormous, and easy movable. The utero-ovarian vessels were greatly distended. The left ovary and accompanying tube were removed and a great portion of tubo-ovarian veins by means of an incision of broad ligament parallel to the round ligament were resected.

Once the varicocele was recognized we immediately inspected the opposite side and as we found it the seat of a beginning stasis we decided to pass two or three ligatures through its most conspicuous veins.

The uterus was enlarged, reddish blue in color and so soft that it could be molded between the fingers, a condition not previously observed by us.

The removed ovary was cut along its median line, giving a splendid view of the engorged veins. Microscopical examination showed a varicocele and œdema of the ovary. The removal of this organ was, as is demonstrated, not justified.

CASE 2. E. D., age 34, multipara. As a result of a violent strain five years ago, she felt an intense pain on both sides of the lumbar region. The pain, though less severe, has persisted since that time. The periods are irregular and painful. She complains of pain on the left side of the hypogastrium. The pain is more marked when menstrual flow approaches.

The light kidney is slightly mobile; the uterus is small, a little retroverted and movable; the left appendage is enlarged and tender to pressure. A diagnosis of retroversion of the uterus and left adnexitis was made. Operation, August 26. The left ovary and tube were absolutely normal. The tubo-ovarian venous vessels on the left side were more dilated than usual. The right ovary was microcystic. The veins were very large giving to the broad ligament a rather striking bluish color. The most prominent vessels were ligated; the appendix removed, and both round ligaments were shortened (Doléris-Richelot).

It is interesting to note the co-existence of sclerocystic ovaritis and varicocele. I think it is very likely that the former is the end-result of a prolonged stasis. I do not claim to prove that such is the only cause of this enigmatic ovarian disease; my object is to explain the relationship if any, between the diseases.

The surgeon may find upon opening the abdomen that no veins appear and he may thus fear a mistake in diagnosis has been made, but the explanation is very easy; as the Trendelenburg position favors venous circulation, the pelvic veins, following the general rule, empty with incredible rapidity and everything appears normal. In the patient whose history I have just given and in the next one I could conclusively demonstrate this phenomenon. This is, I think, the cause of mistake in a patient where the palpating hand very distinctly discovered besides the ovary and tube, many soft and elongated masses which disappeared after prolonged pressure. I was justified in making a tentative diagnosis of pelvic varicocele and fibrocystic ovary. The operation did not confirm the pre-operative diagnosis.

CASE 3. M. A. C., age 38; X-para; menses of four days' duration until that time, since then they are regular and last a week. The portio vaginalis is large and hard; the corpus is enlarged. The uterine probe induces bleeding. The right ovary is easily palpated, is the size of a peanut, and is soft, fluctuating, and not tender to pressure.

Diagnosis: cyst of right ovary, chronic metritis.

The laparotomy was performed under spinal analgesia (Jonesco), and the diagnosis verified. A varicocele of the same side was also discovered. The veins were enormously dilated and they completely collapsed as soon as the supine position was assumed.

We opened the layers of the broad ligament and

resected a few centimeters of the most prominent veins. The ovary was the seat of a serous cyst, and, covering the surface of the tube, there were numerous small cysts; both ovary and tube were removed. The appendix was removed. The left broad ligament and appendage were normal.

From all we have said the conclusion to be drawn is that this disease is not so rare as is usually thought and as would be indicated in the papers written on the subject. It has been regarded as an exceptional condition because we do not expect to find it and because even when diagnosed we sometimes fail to recognize it, as happened to me.

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PURPURA HÆMORRHAGICA FOLLOWING MENORRHŒA

BY FRANCIS ROE BENHAM, M.D., SYRACUSE

IN presenting a paper on the subject of purpura hæmorrhagica following menorrhœa, it is not the purpose of the writer to discuss or spectulate on the etiology of this condition. However, the cause of the condition is and has been a matter of a great deal of theorizing and experimentation, and I will therefore give a few of the theories advanced.

Briefly, purpura hæmorrhagica may be defined as an abnormal condition of the blood or blood-vessels and possibly both, characterized by the appearance of hæmorrhages in different parts of the body. These hæmorrhages may be subcuticular, submucous, or subserous; in fact they may appear in any part of the body. The subcuticular varieties appear under the skin and vary in size from a small pin point (petechiæ) to the large ecchymotic patch. The submucous is found, as the name implies, under the mucous membranes. Its size and appearance is not unlike the subcuticular. The subserous are found under the serous membranes.

The case which I shall report had all these different varieties of purpuric hæmorrhages.

There are many theories and opinions expressed as to the causation of this malady. Certain infectious diseases, such as typhoid and malaria, seem to produce a condition of the blood that not infrequently leads to attacks of purpura hæmorrhagica.

Letzerick believes purpura hæmorrhagica to be of infectious origin and has isolated a bacillus not unlike the bacillus of anthrax. Auto-intoxication is said by others to be a causative factor in the production of this disease. It is thought that certain toxins absorbed from the intestinal tract so act upon the blood or blood-vessel, or both, that coagulation is interfered with and as a result we have the hæmorrhagic diathesis with production of purpura.

Silbermann believes that in these cases blood-pressure in the capillaries is greatly increased and as a result some of the small capillaries may rupture and thus throw blood into tissues. Again, it is said to be produced by a process of diapedesis.

Kogerer and Silbermann, who have spent much time in the study and experimentation of this condition, summarize their work as follows: First, the condition is the result of vascular disease. Second, as a result of the vascular disease there is thrombosis formation. Third, following the thrombosis there is extravasation of blood. Fourth, following extravasation there is a discoloration of tissues and pigmentation.

The many and varied opinions expressed show that the etiology is unknown. I have very briefly gone over some of the literature on this subject to show the wide variance of opinion concerning the cause.

Inasmuch as we do not know the cause of this disease we are compelled to treat the condition. I believe the blood-count to be the first and most important initial step to be

undertaken in the treatment, because if this condition is produced by a lack of certain elements of the blood, these may be artificially supplied. This technique proved to be of great benefit to me in the particular case which I report.

I wish here to indorse the blood transfusion method as given by Richard Lewisohn in the *American Journal of Surgery* under date of October, 1915. By this method the entire blood is injected direct from donor to recipient. A cannula is inserted into the vein and a 20 ccm. syringe filled direct from donor and injected direct into recipient. As large a quantity as is desired may be injected. The technique is the simplest of any blood transfusion operation I know of. It is not, however, without danger to the recipient. If too much blood is injected, or it is injected too rapidly, acute dilatation of the right heart may result. There is also danger of injecting too much air. A small quantity of air can be taken care of, but a large quantity is extremely dangerous.

Purpura hæmorrhagica is found most frequently in women.

In reporting my case, I wish to emphasize the importance of family history, as not infrequently we discover other members of the family to have been likewise afflicted.

A woman, age 34, father 65 and in good health; mother died at the age of 54 of cerebral hæmorrhage; two brothers and three sisters are living and in good health.

As far as I am able to learn none of the ancestors was ever affected with this disease. When the patient was 32 she noticed a few spots on her shins. These were at that time diagnosed as ring-worms, tinea circinata. She has two children, six and nine years of age. Both confinements, hard forceps deliveries. Was lacerated both times but repaired. Never has had any miscarriages. She began to menstruate at thirteen and has always been regular. Menstruation seemed normal as to time and quantity until about two years after the birth of the second child; then she noticed flowing was excessive and it lasted six or seven days.

Purpuric spots would appear on different portions of her body, last a few days, and then disappear.

She did not consult a doctor until 1913, when she moved to Syracuse and consulted me regarding fallen arches. At this time no mention was made of any purpura spots or menstrual trouble. February 1914, she had acute appendicitis. I removed a large, acutely inflamed appendix which was glued at the top to the ileum. Recovery was rapid and she returned home from the Homeopathic Hospital in two weeks. During or following the operation no trouble was experienced from hæmorrhage, neither did any purpuric spots appear.

September 1914, I was again called because of menorrhœa. The menses had at that time lasted eight days and the flowing was increasing instead of abating. I was at first suspicious of miscarriage, or if not that, uterine polypus or fibroid. History and examinations revealed nothing and I was at a loss to account for the continued flowing. Doctor W. A. Groat was called to make a blood count and examination, which was: Red blood-cells, 2,000,000; coagulation decidedly retarded; hæmoglobin 40 per cent; leucocytes, 6,000.

There was profound secondary anæmia with great reduction of blood-platelets. Ergot and pituitrin had been given to assist in controlling hæmorrhage, with no effect. With the knowledge that the coagulating power of the blood was so greatly reduced, horse serum was injected: 10 ccm. every day for two weeks. After a few days the flowing began to decrease in quantity. Menstruation, however, continued from one period into another and finally stopped entirely before the third period. The administration of horse serum hypodermatically was continued before and during the ensuing menstruation with marked benefit in the condition of the blood and appearance of the patient. During the entire sickness, purpuric spots would appear in different parts of her body, these spots varying in size and appearance. They would appear generally one week following menstruation. At first the spots would be the small petechiæ, found scattered over her neck and arms. These would last several days, then the large ecchymotic patch would appear, in different parts. There seemed to be no particular place where they would appear. These would last like any black and blue spot and then gradually fade away. The patient's habits of life were regulated, and proper hygienic instructions were given besides, general tonic treatment and the hypodermic use of iron citrate, etc. There was great improvement in the general condition. She could go and do as she pleased and enjoyed life in general.

April 8, 1915, the menses appeared as usual but the flowing was greatly increased. Vaginal examination revealed an erosion on the scar of the former laceration from which the blood was streaming. Local treatment was instituted to stop the hæmorrhage. Silver nitrate 15 per cent solution was applied followed by packing with gauze saturated in 1:1000 adrenalin solution. The horse serum was injected every day, still I could see no alleviation of the symptoms.

Doctor Groat at this time made another blood examination as follows: Pale; hæmoglobin 30 per cent; erythrocytes 1,600,000; coagulation decidedly retarded; color index 0.8; leucocytes 5,400; secondary anæmia.

The comparison of the last blood count with the first shows the same serious secondary anæmia but to a much greater degree. It also revealed the fact that she was nearly exsanguinated. Her skin was as white as the sheets of her bed, the mucous membranes of her mouth and lips were as white as her skin. The case now assumed very alarming proportions. She was in a condition of shock most of the time, had breath hunger, then she would feel faint. Her body and face were covered with cold perspiration.

At the suggestion of Dr. Meader, coagulose was tried; still the flowing continued. She was literally bleeding to death. At this stage, eight ounces of human blood was obtained from her husband and injected. This seemed to modify the serious symptoms a great deal. The flowing continued irrespective of treatment. Operative interference was advised against, still I could see this continual hæmorrhage coming from the erosion on the cervix. Operation was decided upon and the uterine arteries were tied off followed by curettement. The hæmorrhage was rather severe, but, after the application of pure carbolic acid followed immediately with application of alcohol, the uterus packed with gauze saturated in a solution of adrenalin 1:1000, the hemorrhage ceased. The operation was very well borne.

Human blood serum was injected as often as I could obtain same from husband. Scrapings of uterus were sent to Professor Steensland of Syracuse Medical College for pathological examination, as I felt possibly malignancy might have some bearing on the case. Professor Steensland reported the condition innocent.

Following this operation which was performed at the patient's home, purpuric spots covered her whole body and lined the mucous membrane of her mouth, nose and throat, also many hæmorrhagic spots appeared in the vagina. During this time she had frequent nose bleeds which were very difficult to control, also if she would brush her teeth especially hard so as to erode a small particle around a tooth, this would bleed perhaps twelve or twenty-four hours.

The cervix presented such a large stellate laceration that in my opinion, it would very soon undergo degenerative changes, and I considered this to be one of the chief causes of the menorrhœa.

I decided to amputate as soon as the condition of the patient warranted.

June 16, patient was removed to the Homœopathic Hospital and on June 17 I amputated the cervix. Convalescence was uninterrupted and she returned home in two weeks. The menses appeared every twenty-eight days at first, and were rather prolonged and excessive, lasting about ten days. The condition has materially improved until now the entire duration is five days. One week following the cessation of menses, small petechiæ appear on different parts of her body. There is no pain or tenderness, no symptoms of feeling weak, and no inconvenience of any kind. These spots last a few days and then disappear.

She has gained in weight, weighing 140 pounds, and looks the picture of health. She is able to go and do as she chooses. Examinations of the blood still shows slight anæmia with some reduction of blood-platelets.

Purpuric spots also appear as they have before but the quantity is much smaller. The treatment now consists of proper hygiene and intravenous use of iron.

I have every reason to believe that this case will entirely recover, improvement has been so great and is steadily progressing.

To summarize: The laceration of the cervix in this case produced a subinvolution of the uterus, thus predisposing to increased and prolonged flowing, and reducing the quality and quantity of the blood as a whole. The condition lasting over several years produced vascular disease. The vascular change seemed to have affected the power of the blood to coagulate at the proper time. Blood examination shows that it is the lack of blood platelets that produce the condition. The vascular disease is given by some writers as the first and primary cause of the disease. Constituents of the blood were taken away from time to time faster than the forming elements could supply them. Resulting from this we have a slowing of the blood stream and finally stasis with the formation of thrombosis and pigmentation.

The appearance of the petechiæ and ecchymotic patches following menstruation show that at that time the coagulation power of the blood is at its lowest point; consequently I believe the treatment at this particular time should be to supply if possible the loss of blood by the direct transfusion method; namely, the method of Richard Lewisohn alluded to in the early part of this paper.

THE RELATION OF THE ENDOMETRIUM AND OVARY TO HÆMORRHAGE FROM MYOMATOUS UTERI[1]

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THE commonest and perhaps the most important symptom associated with uterine fibromyomata is undoubtedly hæmorrhage, either in the form of menorrhagia or metrorrhagia. It has been the aim of many investigators to arrive at some definite explanation to account for this hæmorrhage, but as yet no conclusive evidence in support of the various theories has been advanced. Hyperplastic changes in the endometrium have been noted as a common occurrence associated with bleeding and fibroids, and consequently these conditions have been correlated by some authors. Others have attempted to link the hæmorrhage with inflammatory changes, either in the endometrium or in the wall of the uterus. As would seem natural, because of the size and situation of these tumors, mechanical causes, as pressure or obstruction with dilatation of the vessels, have been assigned an important rôle in the etiology of the hæmorrhage. One important organ, however, has been neglected, but in the light of recent contributions to the physiology of menstruation and of the demonstration of amenorrhœa produced by the X-ray in treating fibroids and other conditions, the definite part played by the ovaries in the causation of hæmorrhage must be emphasized.

A brief review of the more important literature illustrates the various theories that have been advanced and shows how little attention has been directed to the study of the ovary as a possible etiological factor.

Von Campe (1) studied sixteen cases of fibromyomata, and found hypertrophy of the endometrium which he believed to be due to the presence of the tumor. Wyder (2) in an examination of twenty cases of fibromyomata noted the frequency of the endometrial hypertrophy, and believing it to be inflammatory called it "endometritis glandularis." He believed that this change in the mucosa had no relation to the hæmorrhage. He found in those cases in which there was a concomitant hæmorrhage that an interstitial inflammation was present and suggested that the inflammatory condition was the cause of the hæmorrhage as well as the cause of the hypertrophy of the mucosa. His pictures, however, do not show a true interstitial inflammation.

In the cases investigated by Uter (3) the same hypertrophy of the mucosa was noted and for the first time was considered apart from the tumor proper. The idea was advanced that some external irritation, the same that in the musculature causes a circumscribed connective-tissue overgrowth, produces an overgrowth of the mucous membrane.

However, to disprove that the tumor produced the endometrial overgrowth, Cornil (4) demonstrated that the hypertrophic change was more commonly associated with small than with large myomata.

In an attempt to ascertain if the situation of the tumor had any effect on the mucosa, Schmal (5), analyzed fifteen cases and found that in subserous tumors the mucous membrane may be normal or hypertrophied; while in the interstitial and submucous ones the endometrium over the tumor usually is atrophic; elsewhere it is hypertrophic.

Semb (6), from a careful examination of fibroid tumors, considering especially their situation, the type of mucosa, and the amount of hæmorrhage, concludes that the commonest change in the mucosa associated with fibromyomata is hyperplasia. There may, however, be changes of a secondary nature such as inflammation or atrophy from pressure. He believes also that the hypertrophy of the uterine walls and vessels and the pressure of the tumor on the veins may cause the hæmorrhage.

With the work of Hitschman and Adler (11) on the cyclical changes in the mucosa, it was necessary to study the effect of the

[1] Work done under tenure of a George Blumenthal, Jr., Fellowship

tumor formation on the normal menstrual cycle. Frankl (7) was the first to investigate the endometrial changes in myomatous uteri in relation to the normal menstrual phases. In the subserous and pure interstitial types of tumor he found that there were no changes in the endometrium that could not be included in the normal menstrual rhythm. In only one case was there a hyperplasia of the mucosa with rather marked œdema, which latter condition was believed to be due to mechanical interference with the circulation. The interstitial tumors with a tendency to grow toward the serosa show no abnormal variation in the cycle and those growing toward the mucosa likewise do not disturb the normal phases. In numerous instances he found a moderate thickening of the mucosa due to œdema and in other instances, where the tumor projected into the uterine cavity, he found pressure atrophy of the endometrium.

Clark (8) examined a number of fibromatous uteri and studied especially the circulatory apparatus by means of injection experiments. He came to the conclusion that the situation of the tumor and its consequent mechanical interference with the circulation was the main factor in causing the atypical hæmorrhage.

An analysis of the foregoing work shows how at variance the different theories are. Most of the investigators, however, have found that the mucosa is often hypertrophic, some attaching to this an etiological significance in relation to the hæmorrhage, while others simply regard the hypertrophy as a coincidental finding.

While von Campe (1) believed that the hypertrophy was due to the presence of the tumor, Cornil (4) was able to show that the size of the tumor had nothing to do with the hypertrophy and that the larger the tumor the less likely was one to find a hypertrophic mucosa. This seems to throw considerable doubt on the theory of von Campe.

Frankl's contention that the thickening of the mucosa is due to œdema is not borne out by histological examination; microscopically one can see not only œdema and congestion, but hyperplasia and hypertrophy of both the glandular elements and the cellular constituents of the stroma. The conclusions of Clark that the hæmorrhage is due to a mechanical condition will be discussed later, but we believe that this theory of mechanical obstruction is not the entire solution or even the most important factor.

TABLE I.

No. of Cases	Situation of Tumor	Condition of Mucosa		
		Hypertrophy	Interval	Atrophy
6	Submucous (3 large, 1 small)	4	2	
10	Intramural	8	1	1 (bleeding 2 weeks; 47 years old)
1	Subperitoneal with polyp	1		
2	Intramural with polyp	1 (1 polyp hypertrophy)		
1	Cervical	1		
13	Intramural and submucous	9	2	2 (1 had myomectomy before)
9	Intramural and subperitoneal	8	1	
5	All types	3	2	
1	Subperitoneal and cervical		1 late	
1	Subperitoneal and intraligamentous		1 late	
1	Intraligamentous	1		
50	.....Total.....	36 (1 polyp)	10	3

In an attempt to correlate these various theories especially in the light of recent contributions to the physiology of menstruation and its relation to corpus luteum evolution, I studied seventy-five fibromyomatous uteri, representing all types of tumors and presenting various symptoms. In all the cases the menstrual history was accurately investigated. In sixty cases the adnexa were also examined. Of the seventy-five cases, fifty gave a history of menorrhagia, some few also having metrorrhagia.

If we analyze the histological changes in these fifty cases we find that in thirty-six or 72 per cent, the mucous membrane of the uterus showed hypertrophy irrespective of the phase of the normal menstrual cycle. In one case the mucosa was not examined, but an adenomatous polyp was present, the glandular elements of which had the same charac-

TABLE II.

No. of Cases	Situation of Tumor	Condition of Mucosa		
		Hypertrophy	Interval	Atrophy
5	Intramural	3	2	
3	Intramural and submucous		3	
9	Intramural and subperitoneal	2	5 (2 polyps)	
3	Subperitoneal	2	1	
4	Intramural and polyp	2	2 with polyps	
1	Intramural and intraligamentous		1	
25	.....Total.....	9	14 (2 polyps)	

teristics as those to be described as typical of the hypertrophic endometrial condition.

In three instances there was an atrophy of the mucosa, associated with large tumors, due in all probability to pressure, and in ten instances the endometrium was in the resting, or interval stage, though in two of these it approached the hypertrophic picture. In other words, the most common condition found in the mucosa in the bleeding cases is an hypertrophy.

A closer investigation of those cases that had abnormal bleeding and did not show the typical picture in the mucosa, is instructive. Of the thirteen cases that showed abnormal bleeding and did not present the usual hypertrophic mucosa, five showed a condition of slight hypertrophy and œdema with some tortuosity and dilatation of the glands; in other words a mild attempt at the usual picture. Three cases had atrophic mucosa associated with large tumors. The atrophy, however, occurred over the tumors and on the uterine wall opposite them, where the question of pressure undoubtedly played a prominent part, while the mucosa between the tumors showed decided hypertrophy. Five cases presented the typical interval or resting mucosa. In these five cases we have no explanation to offer for the absence of the hypertrophy. An analysis of Table I will show how absolutely independent the mucosal change is of the situation of the tumor and also of its size.

Of the twenty-five cases in which the menstrual history was normal, Table II illustrates the relation between the situation of the tumor, the menstrual cycle, and the condition of the mucosa.

In this group of cases we have but nine, or 36 per cent that presented the hypertrophic change, and fourteen, or 56 per cent showing an interval stage. In two cases no examination was made of the mucosa, there being present in these instances adenomatous polyps. Of the nine cases with normal menstrual histories in which the mucosa was hypertrophic, one was menstruating on admission. Seven were operated upon at the time of the normal premenstruum. One, a patient of 40, had amenorrhœa for four months. Of this group only the last case cannot be explained as due to physiological causes.

In other words, irrespective of the size and situation of the tumor in those cases giving a history of metrorrhagia or menorrhagia, and irrespective of the phase of the menstrual cycle, we find a markedly hypertrophic mucosa. It is not œdema alone, for all the elements of the endometrium take part in the change. The glands are tortuous, distended, often cystic and sometimes increased in number. The cells lining them are large, with pale staining protoplasm and contain basal or centrally placed nuclei, dark staining and oval in shape. The cell border toward the gland lumen is often raised in the form of a little cap or knob which is granular and when stained by selective dyes shows the same tinctorial characteristics as the secretion which is almost always found in the gland lumen.

The cells of the stroma are somewhat enlarged and pale, the nucleus small, round or oval, deeply staining and centrally placed. Where there is much interstitial œdema the cells are separated for a fair distance but in the absence of œdema the cell-bodies are barely distinguishable and the cells closely crowded together. There are no evidences of inflammatory reaction as a rule, though occasionally one may find inflammatory cells. Blood extravasations are found, though not often. These are situated under the mucosa or in the interstitial tissue.

Fig. 1. Normal premenstrual hypertrophy.

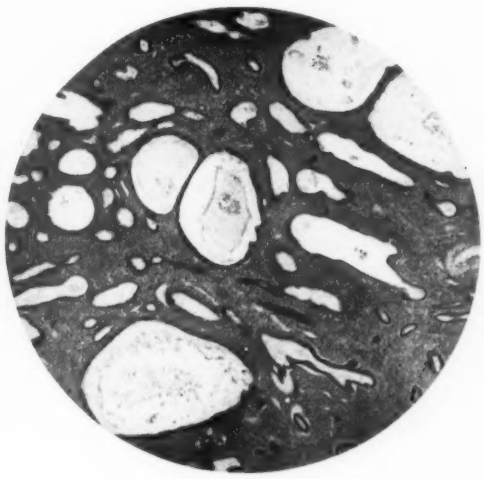

Fig. 2. Mucosa from uterus containing intramural tumor. Atypical dilated glands. Last period five days ago.

The entire histological picture resembles very much the changes one finds in the mucosa during its normal premenstrual phase and it seems reasonable to suppose that the same stimulus, namely, some ovarian activity, is the cause of the hypertrophy found associated with fibroids. In the uteri from the cases of essential uterine hæmorrhage (Geist, 10) we find a similar hypertrophy of the mucosa and this type of hæmorrhage is now generally conceded to be due to a disturbance of the balance of the endocrinous glands.

In an effort to ascertain if there were any definite lesion in the ovaries, the ovaries in fifty-five cases were also carefully examined. In thirty-eight there was a history of bleeding and in seventeen the menstrual history was normal.

TABLE III

Condition of ovaries in the 38 patients with pathological bleeding:

With large corpora lutea	19
9 with cystic corpora lutea, 3 the size of a plum	
With normal ovaries	10
With cysts (one complicated by a dermoid)	4
With inflammation of tube and ovary	5
Total	38

TABLE III A

Condition of ovaries in 26 patients with pathological bleeding and hypertrophy of mucosa:

With large corpora lutea	16
(3 showing luteum cyst the size of a plum)	
With normal ovaries	3
With cysts	3
With inflammation of tube and ovary	4
Total	26

TABLE III B

Condition of ovaries in 12 patients with pathological bleeding and no hypertrophy:

With large corpora lutea	3
With normal ovary	7
With cysts (small dermoid)	1
With inflammation of tube and ovary	1
Total	12

TABLE IV

Condition of ovaries in 17 patients with normal menstrual history:

With large corpora lutea	2
With normal ovary	9
With cysts (3 microcystic, 1 dermoid)	5
With inflammation of tube and ovary	1
Total	17

Fig. 3. Mucosa from uterus containing submucous fibroid. Atypical glands mimicing the premenstrual phase. Last period one week ago.

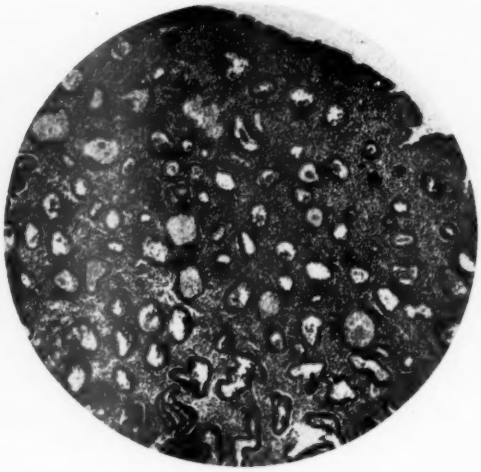

Fig. 4. Mucosa from uterus containing submucous fibroid. Atypical glands mimicing the premenstrual phase. Last period one week ago.

TABLE IV A

Condition of ovaries in 7 patients with normal menstrual history and hypertrophic mucosa.

With large corpora lutea (microcysts)	2
With normal ovary	4
With cysts	1
Total	7

TABLE IV B

Condition of ovaries in 8 patients with normal menstrual history and no hypertrophy.

With normal ovary	5
With cysts	2
1 microcyst, 1 dermoid	
With inflammation of tube and ovary	1
Total	8

In considering the adnexal changes in relation to the bleeding and to the changes in the mucosa, we are struck by the predominance of one type of lesion in the ovary; namely, the persistence of a large corpus luteum which is occasionally cystic. In sixteen cases, or sixty-two per cent of the twenty-six with hypertrophy of the endometrium we found this condition of persistent corpus luteum, and only in three instances were the ovaries to be classified as absolutely normal. In the nine cases in which the mucosa was in the resting stage only two showed this ovarian change and in one of them there was a slight hypertrophy of the endometrium.

Of the seventeen cases in which the menstrual history was normal, only two showed the large corpora lutea, and in these there was a premenstrual change in the mucosa.

An analysis of the foregoing cases shows that when the mucosa is hypertrophic and pathological bleeding is present, the ovary is grossly abnormal presenting either cysts, inflammation, or, most commonly, a large corpus luteum, often cystic in character.

We have seen that in the majority of cases of uterine fibroids irrespective of their size or situation, when the condition is associated with pathological bleeding the mucosa presents a hypertrophic condition resembling that seen in the normal premenstrual phase of the menstrual cycle. The recent work of Ruge and Meyer (9) has shown that the normal premenstrual phases correspond in time to the height of development of the corpus luteum and that the hypertrophy of the mucosa is probably due to ovarian activity or more specifically to corpus luteum activity. We thus have reason to believe, because of the resem-

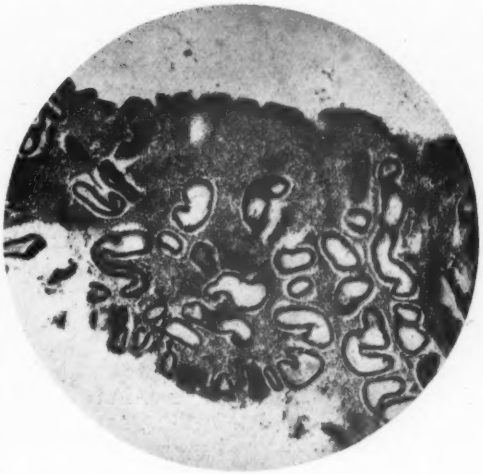

Fig. 5. Mucosa from uterus containing subperitoneal tumor. Atypical dilated glands mimicing the premenstrual phase. Bleeding at present. Fourteenth day of period.

Fig. 6. Mucosa from uterus containing intramura fibroid. Tortuous, atypical, dilated glands. Last period one week ago.

blance between the two pictures of the mucosa, that the same stimulus, perhaps perverted, is the cause of the hypertrophy of the mucosa in the fibroid cases. In most of the cases where atrophy was found this condition could be accounted for either by pressure from large tumors or by senility. In two of the cases where there had been pressure atrophy we found in the spaces between the tumors a hypertrophic condition which resembled that usually found in the bleeding cases. It is not possible to account for the change in the mucosa purely on the basis of a vascular obstruction, for in cases with subperitoneal and small intramural tumors, where there is no marked vascular obstruction, we find the same hypertrophic change of the endometrium associated with pathological bleeding. Furthermore this change is not purely a passive œdema and engorgement but is an active increase in size and sometimes in number of the glandular and stroma elements.

Again in fibroid cases where a normal menstrual history is obtained we find the mucosa corresponds to the normal phase in the menstrual cycle while in other cases presenting tumors of the same size and situation in which atypical hæmorrhage is the prominent symptom, the mucosa in the great majority of instances is hypertrophic.

In some instances where we were led to expect the hypertrophy, we occasionally were embarrassed by finding a different condition. Occasionally there was an atrophy of the mucosa which could be accounted for by pressure from large tumors and in a few instances localized hypertrophies in the form of polyps were encountered whose histological constituents closely resemble those of the hypertrophic mucosa commonly associated with the bleeding cases. We are led to suspect that, in many instances of bleeding in which the only lesion found is a polyp, the bleeding is really of ovarian origin and that the polyp represents a localized hypertrophy due to disturbed ovarian function. Because of the resemblance between the histological picture of the hypertrophy associated with the bleeding and that normally present in the premenstrual phase, which latter condition has been shown to depend on some ovarian function (probably the corpus luteum), we are led to believe that the change seen in the bleeding fibroid cases is an expression of disturbed ovarian function and that the bleeding and hypertrophic mucosa

have a common or related etiological factor. In further support of this theory can be advanced the evidence of X-ray therapy. It is established that the X-ray treatment of bleeding fibroids quickly stops the hæmorrhage long before the size or situation of the tumor is influenced. We also know that it is the ovary and more particularly the more mature follicles that are first affected by the ray, and consequently feel justified in regarding, not the tumor but the ovary as the important factor in the cause of the bleeding.

Supportive evidence pointing to the activity of the ovary as the source of the hæmorrhage, is found in the clinical behavior of fibroids associated with pregnancy. The hæmorrhage from fibroids during pregnancy in most instances, though the tumor in its size and situation remains unchanged, ceases. The ovarian activity is to a great extent in abeyance during pregnancy and it seems that in view of the previous discussion we are justified in assigning the important rôle in causing the cessation of the hæmorrhage to the functional inactivity of the ovary.

To summarize, we can say that in most of the cases of fibroid uteri associated with pathological bleeding we have a hypertrophic condition of the mucosa. The ovaries in these cases vary from the normal, there being present most often a large corpus luteum, occasionally cystic. These findings seem to us very significant in view of the fact that the ovarian influence is of primal importance in regulating the normal hæmorrhage from the uterus, and it seems reasonable to suggest as a possible etiological factor for the atypical hæmorrhage associated with fibroids, disturbance in the function of the ovary, perhaps of the corpus luteum.

I wish to thank Dr. F. S. Mandlebaum, director of the laboratory, for the privilege of studying the material and for the excellent photomicrographs which he made, and also to express my appreciation to Dr. J. Brettauer and Dr. F. Krug for their kindness in allowing me the use of the clinical data.

(The photographs illustrate variations, from the normal picture, as seen in the uterine endometrium associated with fibromyomata. The varieties pictured represent types of hypertrophies where one would normally expect a resting stage.)

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SARCOMA OF THE SCAPULA; HISTOLOGICAL DIAGNOSIS MADE BY STUDY OF BLOOD ASPIRATED FROM PULSATING PORTION OF THE TUMOR

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THE cytological study of the various exudates is a well recognized laboratory procedure and has a proved value in distinguishing between neoplasms and various types of imflammatory processes affecting the linings of the serous cavities. That a similar study of fluids aspirated from tumor-masses may have a like value seems possible from the instance I shall relate.

Among the specimens coming to the laboratory recently was ten cubic centimeters of fluid blood. The accompanying request card stated that the fluid had been aspirated

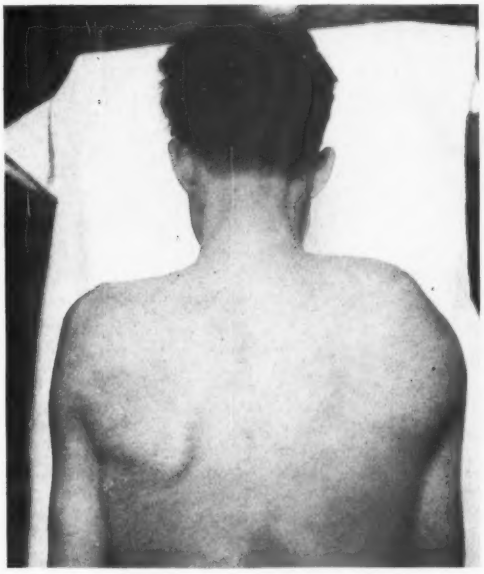

Fig. 1. Photograph showing tumor of right shoulder.

from a tumor of the shoulder which was tentatively diagnosed as sarcoma, and asked for the nature of the fluid. The fluid was allowed to stand over night at room temperature. The next morning it was clotted. Ten per cent formalin was added without disturbing the clot. The following day a portion of the clot was removed and imbedded in paraffin. Sections from this block stained with hæmatoxlin and eosin present beautiful pictures of islands of sarcoma-cells imbedded in a matrix of fibrin and red cells. The cells are of the small round variety and mitotic figures are frequently seen.

The history shows the patient to be a white male, 19 years of age, single, of good habits and without previous illness. The family history is irrelevant, except for the vague statement that his mother died of a tumor of the stomach. He complains of pain and swelling of the right shoulder. The duration of

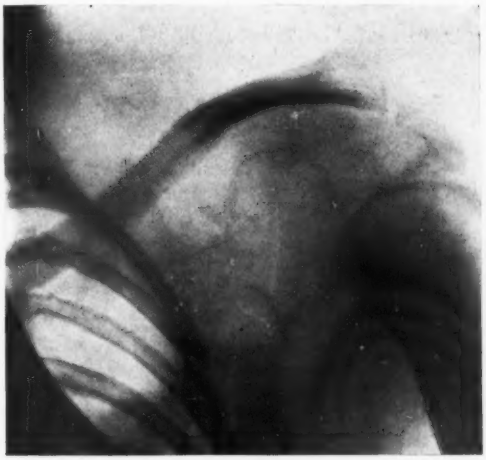

Fig. 2. Roentgenogram showing cavity formation within the tumor.

the tumor covers four years and dates to an injury of the shoulder while coasting. The growth has been slow, but there has always been more or less pain.

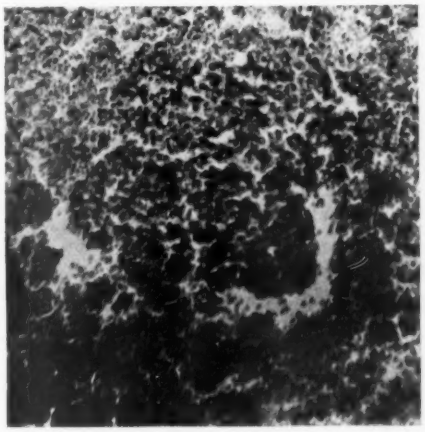

Fig. 3. Photomicrograph showing an island of tumor-cells surrounded by red blood-cells.

UNILATERAL HÆMATURIA ASSOCIATED WITH FIBROSIS AND MULTIPLE MICROSCOPIC CALCULI OF THE RENAL PAPILLÆ[1]

By R. L. PAYNE, Jr., M.D., F.A.C.S., Norfolk, Virginia

DURING the past decade there have been many articles written on unilateral hæmaturia and like all other unsolved pathological problems, there have been quite a diversity of opinions expressed.

At the meeting of this society in 1912 the writer presented a paper[2] setting forth a résumé of the various pathological interpretations published up to that date and related a series of experiments which helped to eliminate the acutely developing vascular lesions as a causative factor of unilateral renal hæmorrhage.

A large number of careful observers have reported the evidences of chronic inflammation in sections of kidney tissue removed from the type of case under consideration and our studies of personal cases before and since 1912 have confirmed the belief that chronic inflammatory changes are the principal factor in the production of unilateral hæmaturia.

We also advanced the theory, in the paper above mentioned, that chronic inflammatory changes raise the local vascular tension to the point where rupture of the capillaries occurs with a resulting hæmorrhage.

The following case is presented, not with the idea of drawing therefrom any definite deductions but for the purpose of explaining and defining our interpretation of the pathology present in this particular case.

C. H. J., male, age 27; occupation, school-teacher; family, past, and social history, negative. Present history: Seven years ago he first observed the presence of blood in the urine. This occurred at varying intervals until three years ago since which time there has been blood continuously present in the urine.

The patient has never suffered a particle of colic or pain, nor has there been associated any spells of fever. The amount of urine passed has always

[2] Surg., Gynec. & Obst., 1913, xvii, 93.

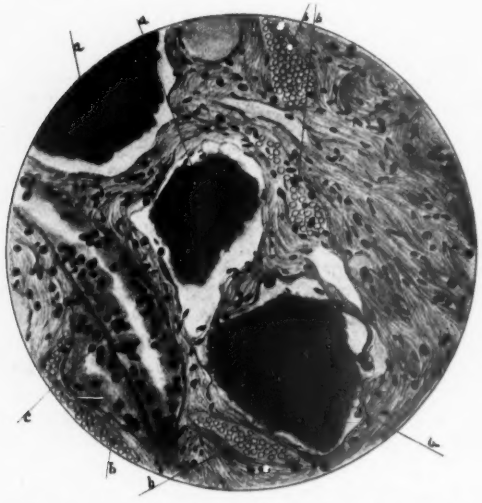

Fig. 1. Camera lucida drawing, Leitz obj. 1/6, oc. 2. Three calculi are shown at *a* surrounded by a proliferation of connective tissue. At *b* are seen dilated capillaries packed with blood-cells. *c*, A papillary duct cut in its long axis.

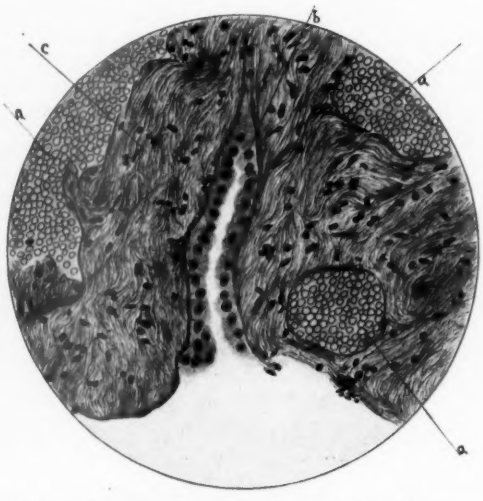

Fig. 2. Camera lucida drawing, Leitz obj. 1/6, oc. 2. Taken from a section through the apex of a renal pyramid. At *a* the enormously dilated venous spaces are seen. The connective-tissue overgrowth at *c* is marked. At *b* is seen a papillary duct cut in its long axis.

[1] Read before the Southern Surgical and Gynecological Association, Cincinnati, December 15, 1915.

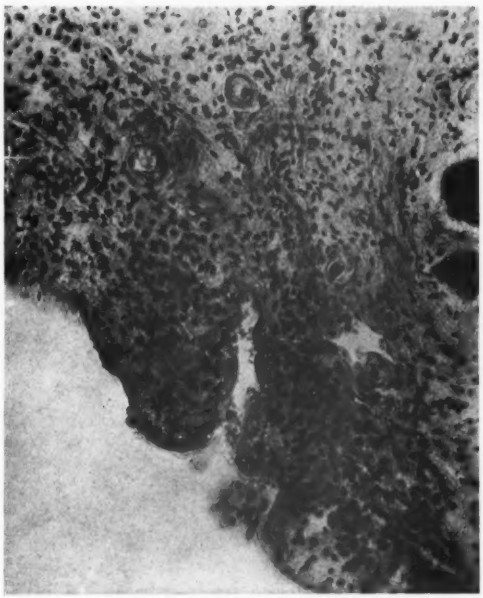

Fig. 3. Microphotograph, X188. Section through tip of papilla. On free surface is seen a ruptured capillary which still contains some blood-cells. Two calculi are also shown.

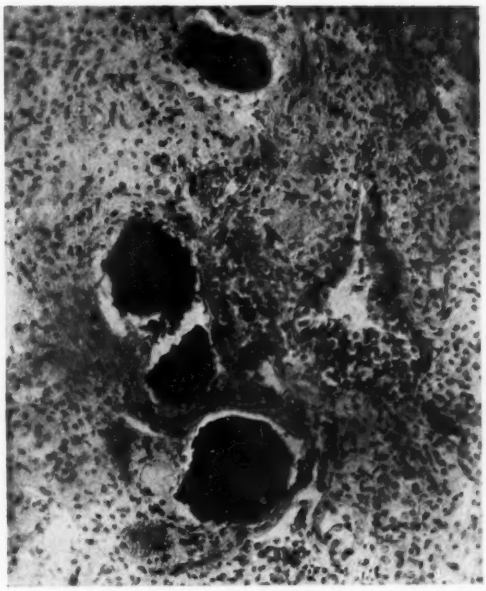

Fig. 4. Microphotograph X152, taken from same section as Fig. 3, shows five calculi, numerous dilated capillaries, and considerable connective-tissue overgrowth.

been plentiful but the patient gives the history of persistent constipation. There had been a perceptible loss of weight and the patient looked very anæmic. On physical examination neither kidney was palpable and there was no tenderness over either loin space. X-ray examination was negative for stone and the microscope revealed an abundance of blood in the urine but no pus, no crystals, and no casts.

Cystoscopic examination showed a normal bladder with bloody urine spurting from the right ureter and clear urine from the left side. No resistance was met with either ureteral catheter, but the separate specimens showed with the microscope clear urine from the left kidney and bloody urine from the right side. Functional phthalein tests showed a normal output from the left side and a marked reduction from the right kidney. Bacteriological studies of the separate specimens was negative from the left kidney but showed a few colon bacilli from the right kidney.

Bacteriological study of the bladder specimen also showed the presence of colon bacilli.

Operation was decided upon because the writer has observed several of these cases relieved by section of the kidney from pole to pole and down to the pelvis in the absence of any demonstrable lesion to the naked eye.

At operation the kidney seemed normal in appearance and size and no stone or new-growth could be demonstrated. Upon bisection the cortex and parenchyma showed nothing definite but every single papilla was intensely congested and the tip of every papilla presented a cherry-red appearance which coincided macroscopically with the classical description of an angioma.

The writer had never before done a nephrectomy for this condition but it did not seem reasonable that bisection with suture could relieve this particular case, nor did it seem possible that the experience of Fenwick[1] could be applied to multiple angiomata of every papilla.

Bearing in mind the normal functional test of the left kidney, nephrectomy was accordingly done and herewith is appended the pathological report by Dr. Wm. DeB. MacNider, of the University of North Carolina.

Gross appearance. Kidney in 10 per cent formalin is 4½x3x1½ inches. The capsule is easily removed, not adherent, and the surface is smooth and normal in color. The cut surface shows a normal relation of cortex and medulla.

The cortex is uniformly pale. All of the pyramids appear congested. This congestion macroscopically takes the form of streaks running in the long axis of the pyramids. In several instances these streaks lead to areas of congestion, reddish-

[1] Brit. M. J., 1900, No. 1, p. 248.

Fig. 5. Microphotograph, X55, showing large section of papilla with ruptured capillary and much hæmorrhage on free surface. Also large number of dilated sinuses scattered throughout section.

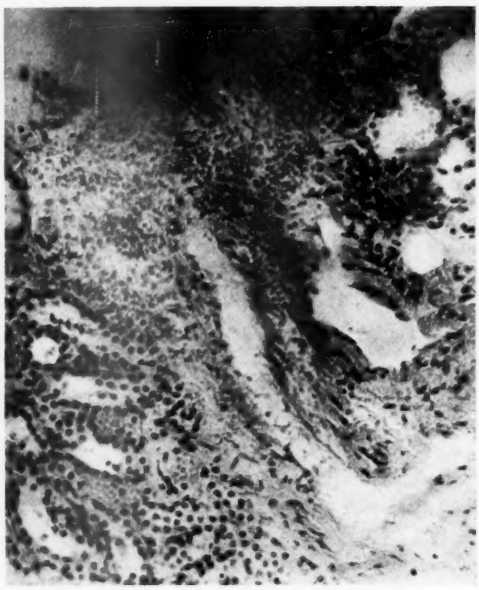

Fig. 6. Microphotograph, X182, of same section as Fig. 5, showing the dilated and ruptured capillary containing a few red cells and abundant hæmorrhage on the surface of the papillæ.

brown in color which surround or cap the apices of the pyramids. All of the renal papillæ show marked congestion.

Microscopic pathology. There is no increase in intertubular connective tissue and no sclerosis of the vessels. The glomeruli do not show any increase in capsular connective tissue. There is, however, quite an uniform increase in connective-tissue cells between the capillary loops of the glomeruli. This connective-tissue change is likely of recent development because connective-tissue fibers have not been laid down.

The capillaries in this area are intact, hence, there is no evidence of the hæmaturia having originated from a ruptured capillary loop or loops. The epithelium of the cortex appears normal. The tubules in the cortex occasionally contain granular material which shows an absence of red blood-cells.

Sections were made passing through the papillæ and pyramids both in the long axis of the pyramids and at right angles to this axis. Such sections show the epithelium of the tubules in this zone of the kidney to be fairly normal. In the region of the papillæ there is a distinct increase in intertubular connective tissue. This increase is not uniform in its distribution.

Located in the region of the papillæ and principally between the tubules but rarely inside a tubule are numerous calculi which are microscopic in size. Surrounding and in the region of such concretions there is an unusual overgrowth of connective tissue. In this connective tissue, usually between the tubules, the small veins and capillaries are hugely dilated into venous sinuses.

Many of the small calculi lie in close apposition to these vascular sinuses. Such sinuses are well filled with blood. In such areas the tubules may be compressed by either the dilated capillaries or the intertubular calculi.

All of the papillæ show dilated capillaries in a network on the surface, many of which were ruptured with free blood escaping. These numerous but small varices were evidently the source of the hæmorrhage.

The origin of these varicosities is not clear. It would seem, however, that the numerous though small calculi, aided by the connective tissue they had originated, succeeded in causing an obstruction to the venous return and a subsequent dilatation of the capillaries with resulting varicosities.

The writer does not believe that deductions can be drawn from one case. The facts here presented would, however, lend weight to the theory of those who believe chronic

inflammation to be the cause of unilateral renal hæmorrhage.

Briefly, to summarize, we have a case of so-called essential hæmaturia which shows in the kidney removed that macroscopically the only part of the organ involved in a pathological process is the papillary area.

Microscopically the cortex and medullary portion is pathologically negative while the papillæ show definite lesions as follows: (1) Numerous microscopic calculi; (2) overgrowth of connective tissue; (3) hugely dilated capillaries; (4) calculi lying in close apposition to dilated capillaries; (5) dilated capillaries in a net-work on the free surface of papillæ, many of which are ruptured with free blood escaping.

It is not the part of this paper to discuss the question of infection, hæmatogenous or otherwise, whether the stones were the beginning of the process, whether the connective-tissue overgrowth was the cause of the varicosities, or in any way to theorize concerning the causative factors involved, but to report accurately our findings and partly show them in the accompanying illustrations.

Finally, after five years of study of so-called essential unilateral hæmaturia, both clinical and experimental, together with an intimate knowledge of the literature, this is the first instance, known to us, where the definite source of the hæmorrhage and the probable cause thereof in a case of symptomless unilateral renal hæmorrhage is shown.

Fig. 7. Microphotograph X152. Section through tip of papilla showing a dilated capillary cut in its long axis. It is still filled with blood but ruptured on the free border of the papilla.

THE PROCESS OF REPAIR IN WOUNDS OF THE SMALL INTESTINE[1]

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IN accordance with a general scheme suggested by the Director of the Surgical Laboratory, to study the phases of repair in the body systems, we have selected the problem of repair in the gastro-intestinal tract with the hope that data might be obtained that would be of practical value in the post-operative care of intestinal suture. The small intestine was chosen first because the undergraduate course in operative technique afforded abundant material. Later we hope to supplement this work with similar observations on the large intestine and stomach.

The objects of these experiments are: *first*, the determination of the hydrostatic pressure that a repairing intestinal wound will withstand; *second*, the effect of transverse division and suture on segmentation; and *third*, an observation of the gross and microscopic phenomena of repair.

HISTORY

In 1887 Senn (1) described experiments on the production of obstruction, vovulus, strangulation, and intussusception, together with the results obtained from resection and subsequent suture of the intestine. During the course of his experiments he reported, though not in detail, a few of the processes of repair. In one series of experiments he produced obstruction by tying the intestine near the ileocæcal valve. Three to seven days later he performed an ileo-ileostomy or ileocolostomy, using decalcified bone plates. One of his dogs died at the end of 24 hours. When the intestine was subjected to hydrostatic pressure, no leakage occurred at the site of suture. He believed that absolute physiological rest of the intestine was necessary for perfect healing. He also reported that scarification or chemical irritation of the peritoneum produced adhesions that were both firmer and more rapid in their development than those following simple apposition of serous surfaces by suture. After mechanical or chemical irritation of the peritoneum an outflow of blood and "lymph" appeared on the surface. He also noted that gross vascularization began after 40 hours. At 15 days the mucosa was almost but not quite completely regenerated.

In 1896 Mall (2) presented a detailed picture of intestinal repair. He noted that within a few hours after the suture, the serous surfaces were adherent and he believed that fibrinous union took place before the operation was completed. At the end of 24 hours the inverted cut edges of the intestine showed extensive coagulation necrosis. After 48 hours, in the sulci between dead and living mucosa, epithelial cells of embryonic type were proliferating in all directions. At the end of 6 days there was a downgrowth of glands into the submucosa, probably because the needle tore through the bottom of the crypts. Many of these glands were cystic. At the end of 14 days, the approximated layers of the muscular and submucous coats were united by firm fibrous tissue. The denuded surfaces of the mucosa were covered with granulation tissue until the crypts and villi had regenerated. On the fifteenth day the mucosa was almost completely regenerated. After 24 days regeneration was complete. When the mucosa had healed, the inverted parts unfolded and the intestinal wall straightened out into a smooth, unbroken line. At the end of two months, all the coats were fully regenerated.

He divided the processes of healing into four stages: *first*, the immediate fibrinous union of the serous surfaces; *second*, the destruction of the parts protruding between the flaps of mucosa; *third*, the regeneration of the mucous membrane; *fourth*, the straightening out of the suture line.

Gould (3) confirmed most of Mall's findings, but noted in addition that the plastic exudate uniting the serous surfaces, extended from 3 to 5 cm. beyond the line of suture. At the end of three days some 3 to 5 mm. of fatally injured mucosa had sloughed and the submucosa was œdematous. Many new

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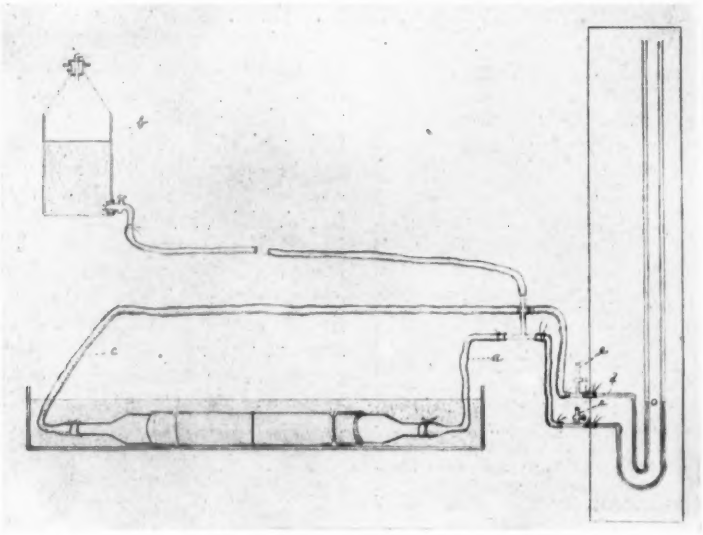

Fig. 1. Diagram of water manometer.

connective-tissue cells appeared in the clot between the approximated serous surfaces and complete organization took place at the end of the eighth day. In one case he found that the denuded surface was covered with embryonal epithelium at the end of eight days. After 21 days the denuded area was completely covered by the newly formed mucosa but the muscularis mucosæ had not developed. The muscularis was approximated by the contraction of the intervening scar-tissue.

According to von Frey, (4) a plastic exudate glued together the approximated serous surfaces of the sutured intestine. He made no direct statement relative to muscular regeneration, although in his drawings of sections taken two days to four months after operation, the muscularis had not regenerated.

Hoffman (5) showed that small defects in the mucous membrane of the stomach and intestine of dogs healed completely. A defect of 5 by 2 cm. had regenerated completely at the end of 32 days, excepting for a small area about 4 mm. in diameter. Larger defects were covered with a single layer of epithelium, while very large defects were covered with granulation tissue.

Meek (6) reported that the longitudinal muscular coats of the cat's intestine regenerated in from 7 to 9 days after division and suture.

Cannon (7) in a discussion of the relative merits of end-to-end and lateral anastomosis, gives his results from observations made on different animals, one, four, seven, and ten days after end-to-end union of the intestine. He found that "in no case was the slightest evidence observed of stasis of the food in the region of the operation." In lateral anastomoses, however, he found at the end of ten days to two weeks, a more or less complete blocking of the canal by accumulated hair and undigested detritus at the opening between the apposed loops.

TECHNIQUE OF OPERATIONS

The experiments were divided into two series; one upon the relatively normal small intestine and the other upon an intestine that had been previously injured.

Series A. The animals in this series were dogs of various types, unselected and often poorly nourished. The operations were done by fourth year students, who had had little if any previous operative experience. Each

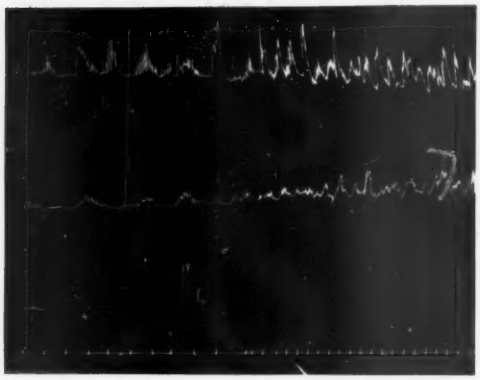

Fig. 1A. Movement of circular coat of intestines one hour after end-to-end anastomosis. Upper tracing made by circular coat 95 mm. caudal to anastomosis. Lower tracing made by circular coat 15 mm. cephalaid to suture. During contraction of the muscles lever moves upward. Lowest tracing time in minutes. Note change in speed of kymograph.

operation was supervised by an instructor, who, however, did no part of the operation. There were three varieties of operations on the small intestine; the repair of enterotomies, lateral anastomoses, and end-to-end anastomoses. The method of suture varied somewhat, but as a rule an inner layer of through-and-through continuous or lock stitch was taken, and this was infolded by some form of continuous seromuscular suture. The suture material was invariably white silk. Since the course is particularly designed to teach operating-room asepsis, special care was taken to maintain as perfect a technique as possible. All the operations of exposing the lumen of the gut were done with a change of towels and instruments between the middle contaminated and the terminal clean stages.

The care of the dogs was as follows: The day before the operation the dogs were given a soap and water bath and the field of operation was cleansed of hair with barium sulphide mixture. All the operations were done in the forenoon, and on that day the dogs received no food at all. The anæsthetic used in every case was ether. Following all operations the dogs were given, as a routine, water on the day of operation, milk and water the next day, and regular diet of bread, meat, and small bones on all succeeding days.

Series B. After completing the first series, the objection was raised that the experiments were inconclusive, since the operations were done on the normal intestine. Consequently we endeavoured to injure the gut by interfering with its blood supply before doing the suture operation. Some difficulty was encountered before a satisfactory method was found. Ligation of the mesentery which included the vessels supplying a loop of intestine a foot in length, had apparently no effect on the viability of the gut. Injecting liquid paraffin into a branch of the mesenteric artery or vein was a little more successful but could not be controlled. Sometimes a loop became moderately hyperæmic but more often there was no effect at all, or there was a general mesenteric thrombosis with gangrene and quick death. Finally a simple, effective and easily controlled method was devised: a piece of half-inch tape was tied about a loop of intestine just tight enough to cut off the venous return while still allowing the entrance of arterial blood. This simulates exactly strangulation of the gut as seen in strangulated hernia, volvulus, and like conditions. This preliminary operation was done twenty-four hours before the second operation, which consisted of wide resection of the strangulated gut and end-to-end anastomosis. In this second series the preliminary operation was done by the experimenters and the resections and anastomoses were done in some cases by students, in others by the experimenters themselves. The method of anastomoses was that already described.

HYDROSTATIC EXPERIMENTS

Technique of experiments. The specimens of both series were handled in exactly the same way. The dog was killed or died at periods from 25 minutes to 144 days following the suture operations. The abdominal cavity was opened as soon as possible after death and a loop of gut was excised which included the area of operation and six inches or more on each side of it. This segment was then treated in either one of two ways. Some had one end tied off and a glass syringe fastened into the lumen at the other. Water was then introduced until the loop was considerably

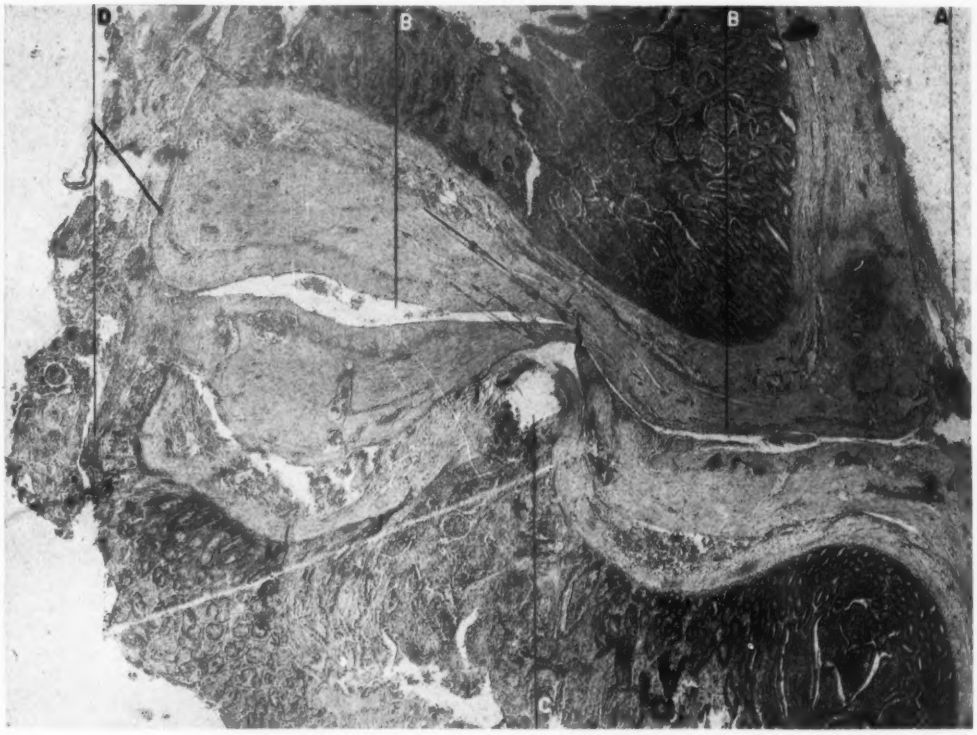

Fig. 2. Lateral entero-enterostomy one hour after operation, Surgical Pathology No. 3262D. *A* Coagulum filling space between approximated serous surfaces; *B* line of approximation of infolded serous surfaces; *C* silk suture passing through submucosa; *D* infolded cut edges of intestinal coats projecting into lumen.

distended. During the distention the suture line was under observation for leakage.

The other specimens were subjected to measured pressure as follows: After removal from the body, the specimen was immersed in warm Ringer's solution and glass cannulæ were inserted into the lumen at either end and securely tied in place. While the gut was still submerged, both ends were connected to the apparatus by means of rubber tubing. One of the connected ends (Fig. 1, *a*) led to a water bottle (Fig. 1, *b*) containing colored Ringer's solution. This bottle was hung from the ceiling and by means of a rope and pulley could be raised and lowered to any desired height, thus giving various hydrostatic pressures. The rubber tubing at the other end (Fig. 1, *c*) was attached to the short arm of the water manometer (Fig. 1, *d*). With the intestine connected to the apparatus, the air was expelled from the lumen of the intestine as well as from the various lengths of tubing, by raising the water bottle. A by-pass (Fig. 1, *e*) with stop-cock in front of the manometer allowed for the escape of air without the disturbance of fluid level in the manometer tubes. Next the water bottle was brought to the level of the intestine and the stop-cock was opened. The level of the fluid in the long arm (Fig. 1, *o*) of the manometer was noted and marked zero, particular care being taken to see that this point did not represent either negative or positive pressure.

To obtain positive pressure within the lumen, the water bottle was gradually raised to any desired height, and the pressures were calculated by measuring the height to which the fluid rose in the long arm. Any leakage

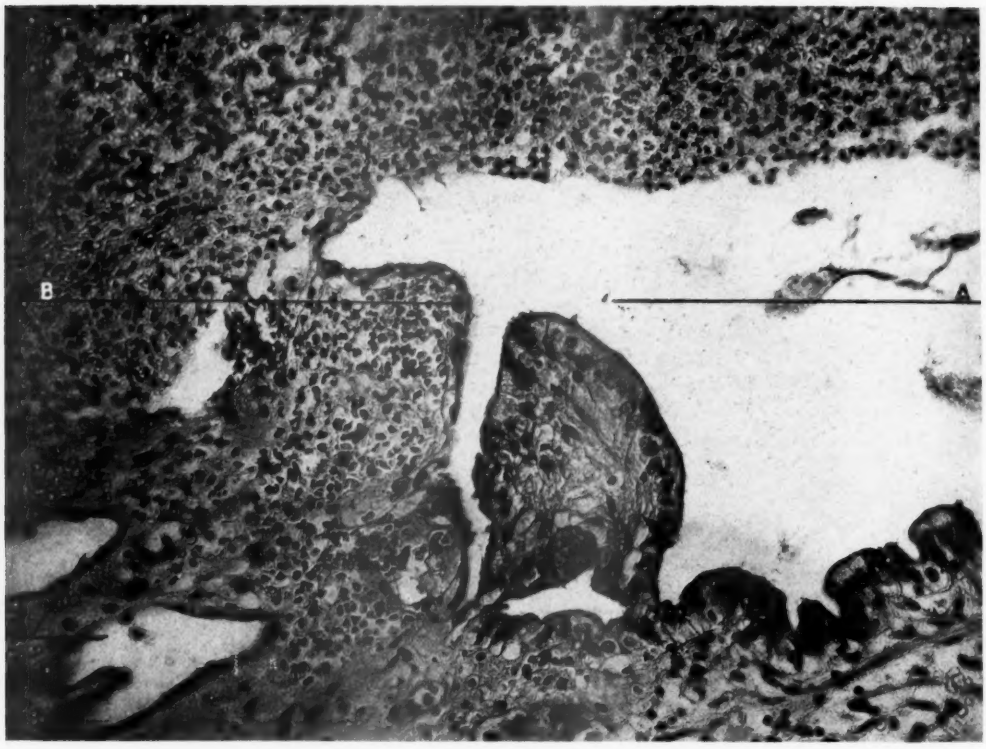

Fig. 3. End-to-end entero-enterostomy 24 hours, Surgical Pathology No. 3312. *A* Sulcus between living mucosa and infolded cut edges of intestinal coat; *B* newly formed epithelial line.

was at once detected, for the Ringer's solution in the water bottle was colored blue with *acridin blau*, a vital stain.

Results of the hydrostatic experiments. As may be seen by referring to Tables I and II, thirty-two specimens in Series A and B, were subjected to various degrees of hydrostatic pressure from within the lumen. As the results in the two series were the same, they will be considered together. Six leaked. Of the twenty-six that showed no leakage, nineteen followed suture of supposedly normal gut, while seven followed resection of gut showing more or less severe vascular changes. The experiments were done at from twenty-five minutes to 144 days following the suture operations. The measured pressures which the specimens withstood without leakage varied from 350 to 1400 mm. of water (one-half to two pounds per square inch). That these pressures far exceed any that under ordinary circumstances exist within the living intestinal lumen, may be readily appreciated by considering for a moment the normally functionating intestine.

The actual amount of positive pressure in the intestinal lumen *in vivo* is unknown. The pressure varies considerably even under normal conditions, for, during the intervals of digestion when the intestine is quiescent, the pressure is practically zero. During digestion, however, with the passage of the bolus along the canal, the internal pressure at any one time and upon any given area is certainly positive, but the actual amount is relatively slight. Even under abnormal conditions of distention, although the pressure is undoubtedly far greater than the average, it

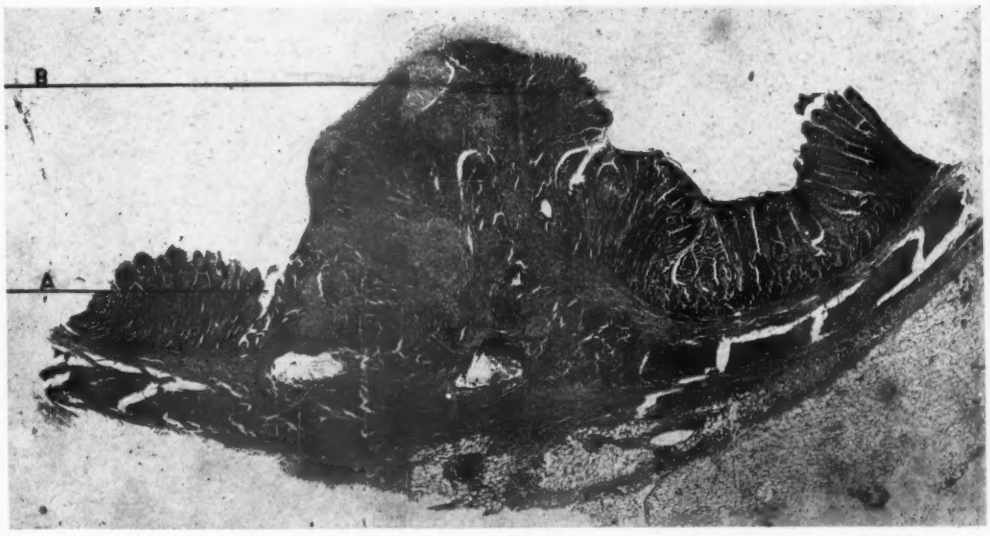

Fig. 4. End-to-end entero-enterostomy, Surgical Pathology No. 3282. *A* Showing sulcus between viable mucosa and denuded area; *B* denuded area covered with granulation tissue and fibrin.

unquestionably never approaches anywhere near the amount to which the above tabulated specimens have been subjected.

Wyllis Andrews (8), working with ox intestine and human intestine freshly removed from the body, found that they burst at an internal air pressure of from 6 to 10 pounds per square inch. Senn (8) experimenting on the cadaver in a case of enteritis, found that the diseased bowel ruptured at an air pressure of 1½ pounds per square inch.

Muller (9) in a recent article on the bursting strength of the alimentary tract, found that in cats the average pressure necessary to rupture the jejunum was 28.2 pounds per square inch (1458 mm. Hg.), and the ileum was 24.8 pounds per square inch (1254 mm. Hg.). This pressure varied considerably in different cats but was uniform in the same individual. He further noted that the tear was linear and ran in the long axis of the organ and that the strength of the alimentary tract lay chiefly in the submucosa.

The six cases of leakage above recorded, together with a number of similar cases, examined but not included in the tables were, with the exception of one case, invariably associated with local infection about the suture line or a general peritoneal infection. The one exception was that of a lateral anastomosis done by one of the students (Table I, No. 1) and tested twenty-five minutes after completion of the suture operation, and fifteen minutes after the death of the dog from the anæsthetic. The leakage here was due undoubtedly to faulty operative technique. What the source of the infection was in the other cases could not be definitely ascertained. In many, a visible hole leading into the lumen was present, and in these cases the leak probably preceded and caused the infection. That other lesions without infection can be present in the intestinal tract without interfering with the repair, is seen from cases seven and fourteen of Series A (Table I). These dogs died respectively of mesenteric thrombosis and intussusception, and yet showed a resistant suture line. That very slight local infection is of no consequence is amply proved by the relatively enormous pressure that some of these specimens withstood though the microscopic picture was that of infection. Given, however, a marked infection whether accompanied by gross

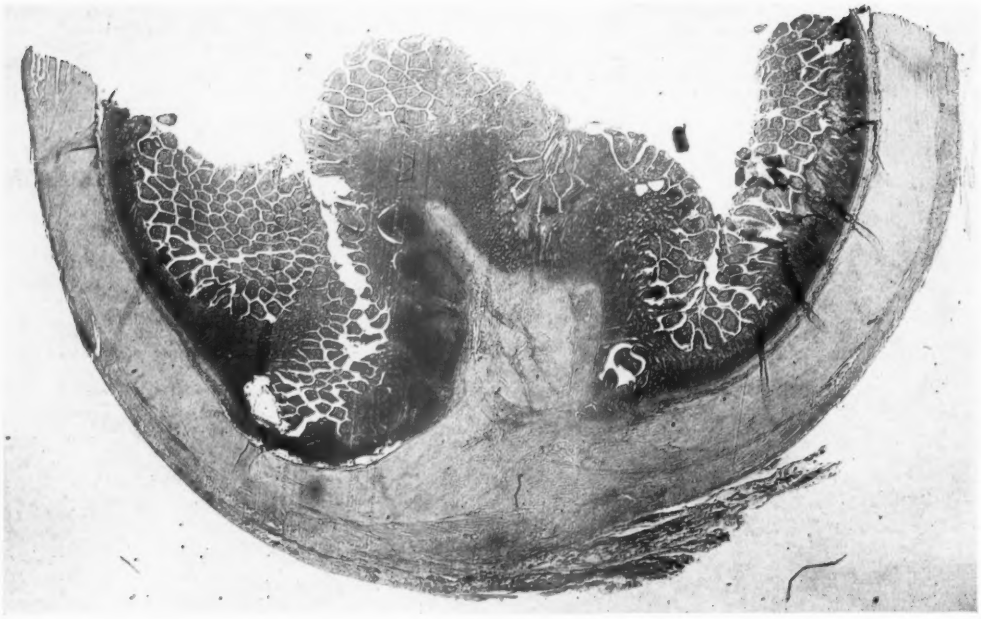

Fig. 5. Enterorrhaphy sixty days after operation (Surgical Pathology No. 3282) showing complete regeneration of mucous membrane and realignment of muscular coat.

suppuration or not, leakage will take place at pressures so slight that they cannot be recorded by the manometer.

In connection with this work on the living intestine, it is of interest to note the two following experiments. A dog was chloroformed and at death the small intestine was divided in two places and immediately joined by end-to-end anastomosis. One-half hour later, one of these sections was removed and subjected to pressure of 850 mm. of water without leakage. Two hours later the second section was excised and subjected to a pressure of 1250 mm. without evidence of leakage.

VIABILITY OF THE INTESTINE

It has been shown in a previous section that an intestine can withstand, within one hour after an anastomosis, an internal pressure varying between 330 mm. and 1400 mm. of water. It seemed worth while to determine whether such operations as anastomoses interfered with the viability of the gut.

No better index of the viability can be offered than a graphic record of the movements of a loop of intestine which includes an anastomotic suture. A preliminary experiment with a loop of dog's intestine one hour after the repair of an enterotomy showed that this operation did not interfere with the contractions of the longitudinal muscular coat. Such an experiment would not indicate whether the contractions were due to movements of muscle-fibers in close proximity to the injury or to those fibers at a considerable distance from the site of operation.

In order to determine the relative activity of smooth muscle near the site of operation and at a considerable distance therefrom, the following experiments were devised:

Immediately after the suture had been tested for its efficiency against internal pressure, the cannulæ which had been tied into the lumen were removed and the loop of intestine was transferred to an oblong dish containing fresh, warm Ringer's solution. The loop of intestine was then fixed by means of two sutures to a glass tube, the ends of which were

TABLE I

Exp. No.	Surg. Path. No.	Time Post-op.	Type of Operation	Cause of Death	Leak or No	Pressure How Obtained	Mm. of Water Press	Lbs. per Square Inch
1	3297	25 minutes	Enterorrhaphy	Died on table, anæsthesia	Slight	Syringe		
2	3259	1 hour	Enterorrhaphy	Killed, ether	No	Water manometer	350	
3	3262D	1 hour	Lateral anastomosis	Killed, chloroform	No	Syringe		
4	3273	1 hour	End-to-end anastomosis	Killed, ether	No	Water manometer	470	
5	3280A	24 hours	Enterorrhaphy	Killed, chloroform	No	Syringe		
6	3312	24 hours	End-to-end anastomosis	Killed, chloroform	No	Water manometer	850	
7	3323	24 hours	Enterorrhaphy	Died mesenteric thrombosis	No	Syringe		
8	3324	24 hours	Enterorrhaphy	Died general peritonitis	Leak	Syringe	0	0
9	3319	48 hours	End-to-end anastomosis	Killed, chloroform	No	Water manometer	820	
10	3275	48 hours	End-to-end anastomosis	Killed, chloroform	No	Water manometer	370	
11	3335	3 days	End-to-end anastomosis	Died general penitonitis	Leak	Syringe	0	0
12	3344	4 days	End-to-end anastomosis	Killed, chloroform	No	Water manometer	860	
13	3282	6 days	End-to-end anastomosis	Killed, chloroform	No	Syringe		
14	3329	14 days	Enterorrhaphy	Died, intussusception	No	Syringe		
14	3329	14 days	Enterorrhaphy	Died, intussusception	No	Syringe		
15	3204	31 days	End-to-end-anastomosis	Killed, chloroform	No	Syringe		
16	3203	38 days	Lateral anastomosis	Killed, chloroform	No	Syringe		
17	3263	48 days	Lateral anastomosis	Died, pneumonia	No	Syringe		
18	3285	51 days	End-to-end anastomosis	Killed, chloroform	No	Syringe		
19	3286	53 days	End-to-end anastomosis	Killed, chloroform	No	Syringe		
20	3281B	60 days	Enterorrhaphy	Killed, chloroform	No	Syringe		
21	3328	64 days	Enterorrhaphy	Killed, chloroform	No	Syringe		
22	3325	144 days	Enterorrhaphy	Killed, ether	No	Syringe		

bent at right angles. Exactly opposite the two original sutures, two other stitches were taken and tied. One end of each of these threads was then passed over a pulley and connected to a recording lever which wrote upon the smoked paper of a slowly-moving kymograph. The levers were properly weighted, and wrote in such a fashion that when the circular muscle of the intestinal loop contracted the writing point moved upward; during the relaxation of the intestinal wall, the writing point descended. Oxygen was supplied to the Ringer's solution which bathed the intestinal loop, and the temperature of this solution was maintained at 38° to 39° C. by means of a large water-bath.

The position of the sutures varied in the different experiments, so that we were able to study muscle within 5 mm. of the site of operation as well as muscle 100 mm. from the line of suture. The accompanying illustration (Fig. 1A) is a graphic record made by the circular muscle of a loop of intestine which was excised one hour after an end-to-end anastomoses had been made. The lower tracing is made by the circular coat 15 mm. cephalad to the suture; the upper tracing represents the movements of the circular coat 95 mm. caudal to the anastomosis. The movements of the muscle 95 mm. from the site of injury are powerful, regular, and show very distinct tonus waves. The movements 15 mm. from the injury are fairly regular and show less pronounced variations in tonus.

Though it is true that all the movements that we have recorded are comparatively small, this may be accounted for, first, by the fact that these loops have invariably been exposed to a very high internal pressure, and, second, to the fact that the dogs have received

TABLE II

Exp. No.	Surg. Path. No.	Time Post-op.	Cause of Death	Leak or No	Mm. of Water Pressure	Lbs. per Square Inch	Type of Preliminary Operation
1	3521	1 hour	Killed, chloroform	No	700		Strangulation with tape.
2	3522	4 hours	Killed, chloroform	No	800		Strangulation with tape.
3	3436	1 day	Killed, chloroform	No	660		Paraffin in mesenteric vessels.
4	3452	1 day	Killed, chloroform	No	680		Strangulation with tape.
5	3468	1 day	Died peritonitis	Leak			Paraffin in mesenteric vessels.
6	3462	2 days	Died general peritonitis	Leak			Strangulation with tape.
7	3453	3 days	Killed, chloroform	No	720		Strangulation with tape.
8	3477	3 days	Killed, chloroform	No	720		Strangulation with tape.
9	3499	5 days	Died, general peritonitis	Leak			Strangulation with tape.
10	3570	7 days	Killed, chloroform	No	1400	2	Strangulation with tape.

The times given above refer to the time elapsing between the second operation and the death of the animal. The second operation in every case in this series was an end-to-end entero-enterostomy. Twenty-four hours elapsed between the first and second operation in every case except experiment No. 8, when only six hours intervened. The pressure in every case was measured by the water manometer.

no food for 12 hours previous to operation. This latter element is probably the more important since Magnus has shown that an animal recently fed shows very much better intestinal contractions than one that has been fasting.

In all the experiments the movements of the gut which are carried out in close proximity to the site of injury are invariably smaller than those made by the intestine 10 or 20 times more distant.

The interval elapsing between the time of operation of anastomosis and the graphic recording of the movements does not modify the strength of the contractions. Thus, in experiments which have been carried out in a dog killed one hour after anastomosis, the contractions are no larger than in experiments that have been made four days after a similar operation. A moderate amount of acute inflammation about the suture line does not interfere with the movements of the muscle, either near the suture or at a considerable distance from it; thus, in one experiment the contractions made by a ring of muscle 5 mm. from the suture were quite as well defined as those made 150 mm. from the suture line.

Only one experiment was carried out on an intestine after gangrene had been produced. In this particular instance, muscle 60 mm. from the suture line contracted well, whereas muscle 5 and 15 mm. from the suture line remained absolutely quiescent. This quiescence cephalad to the injured area would seem to be a protective mechanism. It has been shown that when gangrene occurs the suture line does not withstand an increase in internal pressure. Normal movements of the intestine are undoubtedly associated with an increase in internal pressure. And if weakness occurs at the line of suture, an escape of intestinal contents into the peritoneal cavity will occur. From these experiments, then, it appears that the inhibition of the intestine cephalad to the suture aids in preventing the escape of intestinal contents into the peritoneal cavity.

The movements which have been recorded are not true peristaltic movements. They represent only the segmenting movements of Cannon. No attempt has been made to record graphically true peristaltic contractions. Careful observation has never shown a peristaltic wave spread across the suture line.

The conclusion that may be drawn from these experiments is that, despite the very severe operation, the smooth muscle of the intestine retains its viability and its segmenting function. This function is demonstrable within one hour after the completion of the operation and is present four days after operation. In the presence of gangrene and a leaking suture, these segmenting movements are inhibited cephalad to the suture, whereas caudal thereto the movements are regular, powerful, and well-defined.

ANATOMICAL AND HISTOLOGICAL OBSERVATIONS ON THE PROCESSES OF REPAIR AND REGENERATION

From a gross and microscopic examination of the thirty-two specimens comprising the two series, together with an examination of many similar suture operations done in this laboratory, and a comparison of these observations with those of Mall, Gould, and others, a fairly comprehensive picture of repair and regeneration in healing intestinal wounds has been obtained.

In the course of an operation that divides and then sutures the coats of an intestine, a certain amount of damage is done. The knife that has severed the intestinal coats and the scissors that have trimmed off the redundant mucous membrane, have killed many cells and fatally injured many more. Handling the peritoneum has done some damage to its serous cells. The needle, while passing through the wall of the gut, injures some of the small blood-vessels. It may also tear off the bottoms of some of the glands and crypts of the mucosa, and may even carry living epithelial cells along the suture tract deep into the submucosa or muscularis. Finally slight contamination of the tissues in and about the wound is inevitable.

As a result of these injuries, when the suture operation is completed, the blood that has escaped on the free peritoneal surface and between the approximated infolded serous coats coagulates in a wedge-shaped mass that plugs the line of suture throughout its entire extent (Fig. 2, *A*). There is also a certain amount of coagulated blood in the substance of the intestinal wall and about each suture hole. This coagulated blood is, no doubt, of importance in preventing leakage due to possible faulty operative technique. That it is not essential in preventing leakage if no technical errors are made, would seem probable from the two anastomoses done on the intestine of a dead dog, in which no coagulation of blood took place and yet which did not leak when subjected to extremely high pressures.

Depending on the amount of trauma done to the peritoneum and upon the quantity of blood extravasated, more or less extensive fibrinous adhesions occur. These develop very rapidly between the line of suture and the surrounding serous surfaces, more particularly that of the omentum.

During the first hour following suture, polymorphonuclear leucocytes make their appearance in the region of the wound. They may be seen in and about the engorged blood-vessels, invading the coagula and collecting about the buried sutures. Exudation of serum has begun by the end of the first hour. It is first noticeable between the muscle bundles of the muscularis.

Degenerative changes in those tissues which are fatally injured by the operative trauma no doubt start at once, for it can be seen microscopically, along the cut mucosa edges, four hours after operation.

Reparative processes also no doubt begin very quickly. The infolded cut edges of the intestinal wall make a ridge which juts into the lumen of the intestine (Fig. 2). The summit of this is composed of the exposed cut edges of the intestinal coats. Somewhere on the sloping sides of this ridge are the junctions between the living mucosæ and the denuded area. This junction is often marked by a sulcus (Fig. 4, *A*). Within 24 hours fibroblasts can be observed proliferating just beneath the necrotic tissue and fibrin, which cover the denuded area. Fibroblasts can also be seen beginning to invade the edges of the blood coagula in other parts of the specimen. In the sulcus at the edges of the ridge, the epithelium lining the adjacent intact mucosa starts to proliferate, growing in a flattened syncytial layer over the denuded surface. The appearance of this new forming epithelium closely resembles the embyronal form (Fig. 3, *B*). The cystic downgrowth of newly formed glands into the submucosa has begun by the end of 24 hours. This was described by Mall but he did not observe it until the sixth day.

During the next three days the congestion, the œdema and the leucocytosis are on the increase. Grossly, the fibrinous adhesions become progressively firmer and when torn away leave a reddened suture line with swollen edges. Inside the lumen, the degenerated and dead tissue is separated from the

living and is cast off. The denuded surface of the ridge becomes smoothed over with a thin layer of fibrin, beneath which, granulations are springing up. From the sulci on either side, the epithelium is growing over this smooth surface beneath the fibrin.

In seven to ten days the coagulum disappears and is replaced by new connective tissue. This contracts so that it is difficult to tell, microscopically, exactly where the line of approximation is. The time required to cover the exposed surface of the inverted ridge is extremely variable. It depends largely on its surface measurements and elevation. Mall found it almost covered with a new mucosa after 15 days. In one of our cases it was not completely covered after 38 days. The average is about 23 days. The formation of new glands proceeds almost as rapidly as the growth of the new layer of the surface epithelium. The newly formed mucosa is at first thinner than normal and has no muscularis mucosæ. After two months have passed, however, it is completely regenerated and cannot be distinguished from the surrounding undamaged mucosa.

After the seventh day the fibrinous adhesions between the suture line and the surrounding serous surfaces have, for the most part, disappeared. Those that remain, become organized, so that by the fourteenth day they are dense and fibrous, and can only be torn away with great difficulty. As suggested by Prof. W. C. Clarke, most of these also disappear gradually as the months pass; the movements that go on constantly within the abdominal cavity by gentle traction probably cause stretching of the connective-tissue fibrillæ, disappearance of the blood-vessels, and gradual atrophy and disappearance of the adhesion band. It is common to find after one month only a single narrow band running from the cicatrix in the gut to the omentum or mesentery.

The realignment of the intestinal wall, which is the fourth and final stage of repair according to Mall, was not as complete in our cases as he seemed to find it. In none of the specimens examined by us did the infolded ridge disappear entirely. It undoubtedly grows much smaller. The circular muscle appears to be realigned, but we were always able to see connective tissue interrupting the course of the muscle-bundles. Marchand (10) said in this connection: "The regeneration of the muscle-bundles is not abundant enough to bridge small spaces of a few millimeters—if, however, muscle wound lies against muscle wound, the scar macroscopically would conceal itself in the unbroken line of the fibers." That a certain amount of regeneration of smooth muscle can occur seems certain.

The epithelial lined cysts and tubes with adenomatous growths about them deep in the wall of the gut, which were first observed by Mall, we found in four of our cases, ranging from 51 to 144 days after operation. They occur usually about a buried suture and have many polymorphonuclear leucocytes in and about them. Mall believed that they were implanted by the needle at the time of operation. They appear to be of purely pathological interest and to have no surgical significance.

Some remnants of the silk sutures were found in every case. In the older ones there were usually one or more loose ends lying free in the lumen, covered with gritty material.

SUMMARY AND CONCLUSIONS

The following conclusions based on the data obtained from the operations on the normal and the gangrenous small intestine of the dog, are grouped together for the reason that in both series the experiments were the same and the end-results identical.

1. The non-infected suture line in the small intestine in dogs is very resistant to internal hydrostatic pressure. For at one hour after operation and any time thereafter, the area of operation is capable of withstanding an hydrostatic pressure of over one pound per square inch without leakage.

2. The clinically infected specimens leaked at minimum pressures.

3. To obtain perfect results a proper technique is essential. For it is seen that in a dog recently killed the intestine, when properly sutured, is capable of withstanding a pressure of nearly two pounds per square inch without leakage.

4. Imperfect technique results in a defective suture line. The defects, if not too extensive, may be sealed by the coagulum which probably prevents leakage.

5. The smooth muscle of the divided and sutured intestine retains its viability and segmenting function to within 5 mm. of the line of suture.

6. In an infected case with gangrene around the suture line, no segmentation occurred within 15 mm., while 60 mm. away contractions were powerful and well defined.

7. Repair in sutured intestinal wounds begins at once with the coagulation of the extravasated blood which fills in the space between the two approximated serous surfaces. This union becomes permanent in from 7 to 10 days, with the replacement of the coagulum by connective tissue.

8. Repair of the mucosa is first seen after 24 hours beginning with a line of syncytial epithelial cells extending from the edge of the viable mucosa over the denuded surface of the infolded cut edges of the intestinal coat.

9. The denuded surface may be covered with an immature mucosa as early as the fifteenth day (Mall), but it is usually not completely covered until 23 days after operation.

10. Regeneration of the mucosa is complete after two months.

11. Complete anatomical regeneration of the muscularis does not occur. A realignment of the infolded muscular fibers occurs, but it is always interrupted by a thin line of scar-tissue.

From the above data we conclude that fluid and food may be given immediately after operation without danger of leakage in the sutured small intestine. If leakage does occur, it is due to infection or faulty operative technique.

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THE VALUE OF THE DETERMINATION OF THE CHOLESTEROL CONTENT OF THE BLOOD IN THE DIAGNOSIS OF CHOLELITHIASIS

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SINCE the publication in July 11, 1914 [1] of a preliminary report on this subject, my researches in cholesterinæmia have been continued in the laboratories of the German Hospital. My results seem of sufficient interest and importance to warrant a further, more detailed report of my findings.

Much has been written in recent years on the etiology and pathogenesis of gall-stones. In the light of our newer researches the older theories became almost obsolete, for they failed to take into consideration the fact that cholesterol is a substance which not only is constantly present in the circulating blood and all other body fluids (except urine under normal conditions), but that its amount varies considerably under different pathological conditions and under different clinical states.

[1] E. Henes, Jr. The Value of the Determination of the Cholesterin Content of the Blood in the Diagnosis of Cholelithiasis. J. Am. M. Ass., lxiii, 146.

The formation of a calculus, whether that take place in the genito-urinary, intestinal, or biliary tract, is absolutely a physical process, undoubtedly dependent upon an altered chemical state of the medium in which the calculus forms. Over fifty years ago Thudicum [1] originated the theory that gall-stones were formed by the precipitation of cholesterol and certain calcium compounds as a result of the bile becoming acid. Since the discovery of bacteria, we ascribe chemical changes to bacterial growth and activity. Infection and inflammation of the gall-bladder certainly play a rôle in the formation of gall-stones: bacterial growth in bile alters the chemical composition of the bile; inflammation of the gall-bladder mucosa results in epithelial desquamation and the formation of nuclei for gall-stones. But surely the male gall-bladder is just as susceptible to infection as is the female gall-bladder, and statistics show that 75 per cent of cases of gall-stones are found occurring in females. Gall-stones are not dependent for their formation upon a primary infection of the gall-bladder, for we see many cases of cholelithiasis in which the removed gall-bladders show no evidence of the slightest amount of inflammation. It is just as logical to conclude that the stones are the primary cause of the inflammation.

The most recent, and probably the most generally accepted classification of gall-stones is that of Aschoff and Bacmeister.[2] They classify them as follows:

1. Pure cholesterol stones.
2. Stratified cholesterol calcium stones.
3. Cholesterol-pigment — calcium stones, which are most frequently found.
4. Composite stones made up of cholesterol and a mantle of cholesterol and calcium.
5. Bilarubin-calcium stones, which are seldom found in the gall-bladder, but usually in the bile passages of the liver itself.
6. Calcium-carbonate stones which are very seldom found.

The amount of calcium and bile pigments found in gall-stones is very trifling. From an analysis of many stones — an analysis which sought merely to determine the amount of cholesterol in relation to the whole stone — it can be safely said that cholesterol composes at least 95 per cent of all stones in which cholesterol is a part of their composition.

All authorities, in considering the etiology and incidence of gall-stones agree upon the following facts:

1. Most of the cases are found occurring in females.

2. A very close relationship between pregnancy and gall-stones. Osler [3] in his *Principles and Practice of Medicine* states that 90 per cent of women who have gall-stones have borne children, and Mayo [4] states that 90 per cent of women who have gall-stones and have borne children identify the beginning of the symptoms of cholelithiasis with some particular pregnancy. The relation of gall-stones to pregnancy was formerly ascribed to the excessive metabolic burdens assumed by the liver during the course of pregnancy, burdens which the liver failed to carry on. It seems very unreasonable to believe that the body in general and the liver in particular would fail to assume the extra burdens imposed by so normal and physiologic a process as pregnancy.

3. A relationship between typhoid fever and cholelithiasis. It is needless at this time to elaborate on this subject. Cases of gall-stones following typhoid fever, and cases of gall-stones in those who have had typhoid fever are far too numerous to allow of the assumption of a mere coincident relationship.

The past few years have largely increased our knowledge of cholesterol. The presence of a rather definite amount of cholesterol in the blood under normal conditions has been definitely established. The study of cholesterinæmia under pathological conditions has proved the existence of a hyper- and a hypocholesterinæmia, and our researches have been sufficiently extensive to permit us to conclude in what diseases, and under what clinical states, we can expect a hyper- or a hypocholesterinæmia.

One of the characteristics of pregnancy is a progressive increase in the amount of choles-

[1] The genesis of gall-stones. J. Am. M. Ass., I, 880.
[2] Die Cholelithiasis. Jena: 1909.
[3] Innocent gall-stones a myth. J. Am. M. Ass., 1911, April 8, p. 1023.
[4] Seventh edition, 1910, p. 549.

terol in the blood. At term, a definite hypercholesterinæmia is found and it persists for some time after the birth of the child.

In typhoid fever, as soon as convalescence sets in, we note a decided rise above the normal in the cholesterol content of the blood. This hypercholesterinæmia also persists for some time. We have, therefore, a hypercholesterinæmia, in the two most important etiological factors in the genesis of gall-stones, in the genesis of calculi which are largely, if not entirely, composed of cholesterol.

In interpreting the cholesterinæmia in an individual case, it is of first importance to know the clinical states and diseases which are accompanied by a rise or fall of the cholesterinæmia from the normal. Pregnancy and typhoid fever have already been referred to.

The influence of fever is marked, and always reduces the amount of cholesterol found in the blood. The higher the fever the more marked this influence is.

Progressive arteriosclerosis is accompanied by a moderate hypercholesterinæmia. It is during the stage of the disease before the vessel walls become calcified that this hypercholesterinæmia is noticed. In the old arteriosclerotics, in the type who go on to apoplexies, the increase in the cholesterol of the blood is not so marked. In fact, our researches show that there is actually a reduction, probably due to the deposit of cholesterol in the vessel-wall.

In chronic nephritis, a hypercholesterinæmia is found, except when the disease has gone on to uræmia, when there is a decided fall. For details, I refer the reader to a recent paper[1] on the subject.

Jaundice is always accompanied by an increase of cholesterol in the blood. This is especially true in all cases of obstructive jaundice.

Additional researches in cases of obesity and diabetes will probably show an accompanying hypercholesterinæmia in these conditions.

The normal cholesterinæmia has been placed between 0.00120 and 0.00180 grams per 1 ccm. serum.

Before proceeding with the presentation of cases, I wish to assert very emphatically that despite all that has been said and written for and against this and that method for the quantitative determination of cholesterol in the blood, I continue to find the method outlined in detail in one of my first papers[2] the best and most serviceable.

The following cases are presented to show that a hypercholesterinæmia accompanies cholelithiasis, and that a quantitative determination of the cholesterol of the blood, when properly interpreted, can be, and is, of great diagnostic importance and value. The cases are presented as briefly as possible, and all irrelevant data has been omitted.

CASE 1. Male, age 38 years, admitted to the hospital with the diagnosis of cholelithiasis. No fever, no jaundice, no sclerosis. Besides the rather typical symptoms of gall-stones, the patient showed signs and symptoms strongly suggestive of duodenal ulcer. The stomach analysis was negative. Here was a case in which it was very difficult to make a definite pre-operative diagnosis, and one in whom nothing was found that could influence the cholesterinæmia. The examination of the blood showed the serum to contain 0.00306 gr. of cholesterol to 1 ccm. of serum — an amount far in excess of the normal. Operation revealed the interesting condition of a duodenal ulcer and an inflamed gall-bladder with stones.

CASE 2. Male, age 58. Temperature 101° F.; slight icterus; moderate sclerosis; no evidence of nephritis. Patient has had attacks of colic and jaundice at intervals. On admission to the hospital the symptoms were referable to the gall-bladder. Wassermann reaction negative. Here we have a case in whom there exists clinical conditions which conflict as far as their influence on cholesterinæmia is concerned. The fever tends to reduce, while the slight jaundice and sclerosis tend to increase the cholesterol content of the blood. Blood examination showed 0.00187 gr. cholesterol per 1 ccm. serum, an amount difficult to interpret under the circumstances. Operation revealed a cholecystitis with gall-stones.

The influence of fever on the cholesterol content of the blood is a very definite one, and *always* reduces it. One must constantly bear this in mind in determining the cholesterinæmia in the making of a diagnosis. The following two cases clearly show the influence of fever.

[1] E. Henes, Jr., prognostic value of cholesterinæmia in chronic nephritis. N. Y. St. J. Med., 1915, August.

[2] Untersuchungen ueber Cholesteringehalt des menschlichen Blutes bei inneren Krankheiten. Deutsch. Arch. f. klin. Med., 1913, iii, 122.

CASE 3. Female, age 47 years. Urine negative for nephritis: no jaundice, no sclerosis. Temperature 101° F. in past four days had slowly come down from 103° F. White blood-cells, 21,000; polynuclears, 84 per cent. Symptoms referable to gall-bladder, and a diagnosis of empyema of gall was made. Blood showed 0.00131 gr. Cholesterol per 1 ccm. serum, a practically normal amount. Operation revealed an empyema of the gall-bladder and gall-stones. Eight days after the cholecystectomy, during which time 900 ccm. bile had been drained (entailing an absolute loss of cholesterol to the body), with the temperature at 100 F., the blood showed 0.00247 gr. of cholesterol per 1 ccm. serum.

CASE 4. Female, age 41 years. Urine negative, no sclerosis, no jaundice. Two weeks after a ventral suspension for uterine prolapse, the patient began to complain of severe epigastric pain, and showed signs and symptoms referable to the gall-bladder. Temperature 102.6° F.; white blood-cells, 22,400; polynuclears 85 per cent. Diagnosis: acute cholecystitis. Patient gave no history of typhoid fever, nor did she give any evidence of having it at the time. The blood showed 0.00108 gr. cholesterol per 1 ccm. serum. Operation showed an acute suppurative cholecystitis with gall-stones. A few days later, a positive Widal reaction was obtained and a culture taken from the gall-bladder at the time of operation showed bacillus typhosus. A week after the cholecystectomy, with the temperature 100° F. the blood showed 0.00253 gr. cholesterol per 1 ccm. serum.

CASE 5. Female, age 36 years, admitted to the hospital with a diagnosis of acute appendicitis. Temperature 100° F. Urine showed heavy trace of albumin, and much pus occasioned by a purulent vaginal discharge. Subsequent urine showed no evidence of nephritis. No jaundice, no sclerosis. The acute abdominal symptoms were referable to the right hypochondrium and kidney region, and while under observation, symptoms suggested those of duodenal ulcer and gall-stones. The blood showed 0.00143 gr. of cholesterol per 1 ccm. serum, an amount just about normal. Ten days after admission the patient was operated upon, and a definite pre-operative diagnosis of cholelithiasis was made. Operation revealed an absolutely normal stomach, duodenum, and gall-bladder, and a diseased appendix, which was removed. Here, in my opinion, we had, or rather the surgeons had, an opportunity to make a definite and correct pre-operative diagnosis, in a case which was rather puzzling.

The following case was especially interesting to me, for it chanced to put my ideas on the subject of cholesterinæmia and cholelithiasis to a severe test.

CASE 6. The patient, a physician, about 36 years old, was referred to me, by a colleague, an eminent surgeon in New York. At the time the blood was taken for examination the patient had no fever, urine was negative for nephritis, vessels showed no sclerosis, and he was very slightly jaundiced. The blood and urine did show a trace of bile. Clinically we were dealing with a case of cholelithiasis, with a history of four years. Four days later, the patient developed a pronounced jaundice, which came on rapidly, and the X-ray report, "thickened gall-bladder with shadows suspicious of gall-stones" greatly strengthened the surgeon's faith in his diagnosis. The examination of the blood showed 0.00191 gr. cholesterol per 1 ccm. serum. Under the circumstances, an amount certainly not in favor of gall-stones. About a month later, the patient was brought to the hospital, his jaundice had markedly diminished (and he gave no history of having passed a stone) and an operation performed. The gall-bladder was perfectly normal, and a small lymph-node removed showed inflammatory changes. We all came to the conclusion that we had been dealing with a case of catarrhal jaundice. A proper interpretation and recognition of the value of the cholesterol determination would have avoided an operation in this case.

In presenting these cases, I have selected from a series of more than 100 cases, those which show not only that a hypercholesterinæmia accompanies gall-stones, but that a correct pre-operative diagnosis can be made in those difficult right-sided abdominal conditions which so frequently simulate one or the other of the following conditions: appendicitis, cholelithiasis, duodenal ulcer, and peritoneal adhesions. My series of cases show that a cholesterol determination and a proper interpretation of the amount found is, almost invariably, of distinct value, not only in diagnosis, but in the therapeutic indication.

CASE 7. Male, age 25. Temperature 99.8° F. Urine negative, no sclerosis, no jaundice, symptoms referable to stomach, gall-bladder, right kidney and appendix, a case in which a cholesterol determination could be of value. Blood showed 0.00117 gr. cholesterol per 1 ccm. serum and under the circumstances a diagnosis of chronic appendicitis was made. Operation revealed a normal gall-bladder, stomach, and duodenum, and a chronically inflamed appendix.

CASE 8. Male, age 35 years. Temperature 100° F. Urine showed no evidence of nephritis, no sclerosis, no jaundice. Stomach analysis negative: symptoms were definitely related to the gall-bladder, sufficiently characteristic to warrant a pre-operative diagnosis of cholelithiasis. Cholesterol determination showed 0.00162 gr. per 1 ccm. serum, an amount opposed to the diagnosis made. Operation revealed a normal gall-bladder, with a kink, but no stones, and a chronically inflamed appendix.

In justice to my contentions, and in furtherance of the interest of the cases presented, I wish to add, that the pathological diagnoses, in individual cases, have been taken from the report of the Pathological Laboratory.

CASE 9. Male, age 25 years. No nephritis, no fever, no jaundice, no sclerosis. Symptoms referable to the gall-bladder, and clinically the case was one of gall-stones or duodenal ulcer. The X-ray report was one of duodenal ulcer. The blood examination showed 0.00163 gr. of cholesterol per 1 ccm. serum, an amount not in favor of gall-stones. Operation revealed a perforated duodenal ulcer.

CASE 10. The following case is one for which I have no operative findings to present. It is, nevertheless, an instructive one. Male, age 51 years. Temperature 101.4° F. Urine negative: slight sclerosis. White blood-cells, 12,000; polymorphonuclears, 94 per cent. No jaundice on admission, at which time a diagnosis of appendicitis (with reservation) was made. The symptoms were all referable to the upper abdomen, but without definite local signs other than tenderness over the gall-bladder. Blood examination at this time showed 0.00234 gr. cholesterol per 1 ccm. serum, an amount, which, in the presence of a fever of 101.4° F. is decidedly above normal, and under the circumstances strongly in favor of gall-stones. The day after admission, without any new symptoms, jaundice developed. A few days later, the temperature reached normal, the jaundice had disappeared and all symptoms had vanished, with the result that the patient insisted on being discharged from the hospital. In my opinion, we were, without doubt, dealing here with a case of cholelithiasis.

CASE 11. Here is another case which did not come to operation. I present it because of the decided hypercholesterinæmia found. Male, age 40 years. No fever, no nephritis, no jaundice, no sclerosis. Symptoms were referable to the right hypochondrium, and were strongly suggestive of ulcer of the stomach or duodenum. The blood-serum showed 0.00364 gr. cholesterol per 1 ccm. The patient left the hospital refusing operation. This is just the type of case in which the cholesterinæmia has been most helpful. A case in which the symptoms suggest either an ulcer or gall-stones, and in which the cholesterinæmia is decidedly above normal (no other clinical cause being found that could account for the hypercholesterinæmia). Such a case is usually one of cholelithiasis, and my experience forces me to maintain that opinion despite roentgen-ray findings.

CASE 12. Female, age 46 years. Temperature 102° F. White blood-cells, 12,000; polymorphonuclears, 81 per cent. No jaundice, no sclerosis, no nephritis: stomach analysis negative. Symptoms referable to stomach and gall-bladder. The blood showed 0.00392 gr. cholesterol per 1 ccm. serum. This case also refused operation, but a diagnosis of cholelithiasis is the only one to make under the circumstances, even if the temperature had been normal.

The following case is recorded to show a type in which it is very difficult to properly interpret the cholesterinæmia.

CASE 13. Female, age 68 years. No fever. Urine shows albumin, hyaline and granular casts: no jaundice, moderate sclerosis. Symptoms referable to stomach and gall-bladder. Gastric analysis negative. The blood serum showed 0.00265 gr. cholesterol per 1 ccm. We have here, an adult female, with the sclerosis one would expect, and evidences of a nephritis, two conditions which, in themselves, are accompanied by a hypercholesterinæmia. One cannot depend upon the cholesterinæmia for a definite diagnosis in cases of this sort. Although this case refused operation, the X-ray showed a large, distinct stone in relation to the duodenum. In the straightforward, undoubted cases of cholelithiasis we are, perhaps, not in need of further aids in diagnosis. In my experience, I have not seen a case of gall-stones, verified by operation, without an appreciable hypercholesterinæmia.

CASE 14. Female, age 43. Temperature 100° F. Urine negative, no jaundice, no sclerosis. Clinically a case of cholelithiasis. Serum cholesterol 0.00303 gr. per 1 ccm. Operation, chronic ulcerative cholecystitis with gall-stones.

CASE 15. Male, age 42 years. No fever, no jaundice, no sclerosis, no nephritis. Diagnosis: cholelithiasis. Serum cholesterol showed 0.00380 gr. per 1 ccm. Operation. Chronic catarrhal cholecystitis with gall-stones.

CASE 16. Female, age 23 years. Temperature 99.4° F. No sclerosis, no nephritis, no jaundice. (Had been jaundiced two months ago.) Stomach analysis negative. Diagnosis: cholelithiasis. Serum cholesterol 0.00420 gr. per 1 ccm. Operation. Cholecystitis with gall-stones.

CASE 17. Female, age 40 years. No fever, no jaundice, no sclerosis, no nephritis. Stomach analysis negative; large tender tumor mass in relation to lower border of liver. Diagnosis: cholelithiasis. Serum cholesterol 0.00520 gr. per 1 ccm. Operation. Chronic suppurative cholecystitis with gall-stones.

My researches along these lines have convinced me that a cholesterol determination, when properly interpreted, is of real value in the diagnosis of those obscure conditions, whose symptoms focus attention to the right side of the abdomen. Modern X-ray technique has materially helped us in clearing up these same difficult cases, and especially does that apply to lesions within the stomach and duodenum. Roentgenologists must admit

that they have, as yet, failed to reach a sense of security in the X-ray diagnosis of gall-stones. In the following cases in which I mention the X-ray findings, I do so merely to emphasize the importance and value of serum cholesterol determinations.

CASE 18. Female, age 50 years. No fever, no nephritis, no jaundice, never pregnant, never had typhoid fever. Symptoms are abdominal pains closely simulating those of gall-stones. White blood-cells, 9400; polymorphonuclears, 68 per cent. Stomach analysis negative, except for low acidity: no sclerosis: had never been jaundiced. X-ray report: "Shadows suggestive of gall-stones." The serum-cholesterol equaled 0.00209 gr. per 1 ccm., an amount not sufficiently high to be in favor of gall-stones. After observing the case for several days, a diagnosis of gall-stones was made. Operation revealed a perfectly normal gall-bladder, without stones, and some adhesions about liver and spleen.

CASE 19. Male, age 46 years. Temperature 99 to 100° F. (the day previous had been 102° F.). Moderate jaundice, urine negative. Symptoms referable to right upper quadrant of abdomen, and the case impressed us as a case of gall-stones. Serum cholesterol showed 0.00317 gr. per 1 ccm. and the X-ray department reported: "Mottled shadows suspicious of gall-stones." Operation revealed gall-stones.

CASE 20. Female, age 46 years. No fever, no jaundice, no sclerosis, no nephritis. Symptoms definitely relative to the gall-bladder, and she gave a history of repeated attacks of pain and jaundice. The blood examination showed 0.00300 gr. cholesterol per 1 ccm. serum and the report from the X-ray department was in substance, "no gall-stones." Operation showed a chronic ulcerative cholecystitis with one large pure cholesterol stone, a type of stone which does not show up well on the X-ray plate.

CASE 21. Female, age 26 years. Temperature 100° F. No jaundice, no nephritis, no sclerosis: slightly obese. Symptoms were referable to the gall-bladder. The blood showed 0.00311 gr. cholesterol per 1 ccm. serum, and the X-ray report read: "No evidence of gall-stones." Operation revealed an inflamed gall-bladder containing six large cholesterol stones.

CASE 22. Male, age 28 years. No fever, no jaundice, no nephritis, no sclerosis. Never had typhoid fever. For the past two years he has had symptoms suggesting duodenal ulcer or gall-stones: for a long time had duodenal feeding: seven months ago appendectomy without any relief. Vomiting has always been the chief symptom. The blood showed 0.00107 gr. cholesterol per 1 ccm. serum, and the X-ray department reported "shadows suggesting gall-stones." A diagnosis of cholelithiasis was made. The findings at operation were practically negative, except for adhesions between the gall-bladder, liver and duodenum: gall-stones or ulcer were not to be found.

CASE 23. Female, age 45 years. No fever, no jaundice, no nephritis. Symptoms referable to stomach. Despite a negative stomach analysis, we were, apparently, dealing with a case of gastric ulcer; that, at least, was the clinical picture presented. The blood showed 0.00284 gr. of cholesterol per 1 ccm. serum, and the X-ray department reported "one large gall-stone." A second X-ray picture showed "three large stones." Operation revealed a catarrhal cholecystitis with gall-stones. The gall-bladder contained three large stones and many very small ones. There was no evidence of an ulcer of the stomach.

It will be noted from these latter cases, that the cholesterol determination correctly foretold the condition eventually found at operation, a claim which I cannot make for the X-ray.

CASE 24. Female, age 48 years, was admitted to the hospital complaining of pains and swelling of lower extremities and pain in lumbar regions. No fever, no nephritis, no jaundice (had been jaundiced two years ago), no sclerosis. Wassermann reaction negative; white blood-cells, 8800; polymorphonuclears, 71 per cent; hæmoglobin, 70 per cent. Stomach analysis showed 34 free hydrochloric acid, 64 total acid, no lactic acid, and no blood. The physical examination showed the lower border of the liver reaching to a line connecting the anterior superior spine of ileum with the umbilicus. Its surface was smooth. Below the edge, in the gall-bladder region was a rounded, nodular, hard mass, the size of a walnut, which can be separated from the liver, and is tender. Underneath the liver and more posteriorly in lumbar region, a similar mass can be felt. No Virchow's glands felt. I present this case in more detail because of its interest. The patient's general appearance suggested malignant disease. A neurological examination further suggested the probability of spinal cord metastases. The X-ray examinations of the spinal column and abdomen were negative. A cholesterol determination showed 0.00256 gr. per 1 ccm. serum. Despite this hypercholesterinæmia, a diagnosis of carcinoma of liver or colon was made, and an exploratory operation performed. The surgeons were very much surprised to find a gall-bladder full of stones; it was the gall-bladder that was the mass originally felt. No evidence of malignant disease was found. Subsequent neurological examination of the patient resulted in the conclusion that the symptoms at first thought to be due to malignant cord metastases were due to a multiple sclerosis.

CASE 25. Female, age 29 years. Married, last child 8 months ago. Symptoms referable to gall-bladder began 2 months ago. Never jaundiced and not now. Temperature 100° F. White blood-cells 7800; polymorphonuclears 72 per cent. No neph-

ritis, no sclerosis. Clinically a case of cholelithiasis. Cholesterinæmia, 0.00257 gr. per 1 ccm. serum. Operation revealed a few small stones in the cystic duct.

CASE 26. Female, age 35 years. Temperature 98.8° to 100.2° F. No nephritis, no jaundice, no sclerosis. Four pregnancies, last one eight months ago. Symptoms referable to right upper and lower quadrants. Stomach analysis negative. Cholesterinæmia 0.00291 gr. per 1 ccm. serum. Operation revealed a gall-bladder containing a few small stones and a chronically inflamed appendix.

CASE 27. Female, age 66 years. Ten pregnancies, last 18 years ago. No jaundice. Temperature had been 102° F. the day before the blood was examined. Urine showed a trace of albumin, a few granular casts, and the arteries showed moderate sclerosis. The blood-pressure was 161 mm. White blood-cells, 8,400; polymorphonuclears, 86 per cent. Symptoms referable to the right lumbar region. Stomach analysis showed no free hydrochloric acid and a diminished total acidity. Clinically we were dealing with a case of gall-stones. With a coincident evidence of nephritis and some sclerosis, a moderate hypercholesterinæmia was to be expected. The blood showed 0.00334 gr. cholesterol per 1 ccm. an amount which, in the presence of the 102° fever of the day before, must be looked upon as a decided increase above the normal. In this case I have no post-operative findings. The patient left the hospital refusing operation.

In three private cases which came under my observation, in whom there was absolutely no doubt as to the diagnosis of gall-stones, and in whom there were no coincident conditions that would influence the cholesterinæmia, I obtained figures of 0.00300, 0.00320, and 0.00347 gr. cholesterol per 1 ccm. serum. None of these cases has, as yet, come to operation.

My series of cases includes many, which at operation, showed either ulcer of stomach, ulcer of duodenum, intestinal adhesions, chronic appendicitis, or carcinoma of pylorus, conditions which very frequently are to be differentiated from cholelithiasis. Because I do not consider the facts of interest, I shall not present those cases whose cholesterinæmias verified the operative findings when those findings were other than gall-stones.

Through the courtesy of Dr. Allen O. Whipple, I was permitted to examine the blood of several cases referred by him from the services of Drs. Brewer, Elliot, and Longcope of the Presbyterian Hospital.

CASE 28. Female, age 37 years. Sixteen pregnancies, no jaundice, no sclerosis, no nephritis. Temperature 101° F. White blood-cells, 12500; polymorphonuclears, 80 per cent. Symptoms and physical signs all referable to the gall-bladder. Serum-cholesterol amounted to 0.00430 grs. per 1 ccm. and would have been even higher with normal temperature. Diagnosis of cholecystitis with gall-stones was made, and operation verified it. About 18 calcium, bilirubin, cholesterol stones were found in the gall-bladder.

CASE 29. Female, age 33 years. Typhoid fever 25 years ago. Present history dates back seven years, and began while she was four months pregnant. Has had four attacks in seven years, of epigastric pain, nausea, vomiting and jaundice. At present no fever, no nephritis, no sclerosis, but very slight icterus. Serum-cholesterol showed 0.00252 gr. per 1 ccm. serum. The diagnosis of cholelithiasis was verified at operation and fifteen small, mulberry-like, cholesterol calcium bilirubin stones found.

CASE 30. Female, age 54 years. Pain in epigastrium, nausea, vomiting, chills, fever, and jaundice coming on in "attacks." First "attack" sixteen years ago, after her first pregnancy: has been pregnant four times since then. At the time the blood was examined the patient was slightly jaundiced, had no fever, no sclerosis. White blood-cells, 27,300; polymorphonuclears, 90 per cent. Wassermann negative. Urine showed very faint trace of albumin and 2.5 per cent sugar. The blood sugar equals 0.146 per cent. Cholesterinæmia in this case amounted to 0.00276 gr. per 1 ccm. serum. This patient was not operated on, but during her stay in the hospital several facetted gall-stones were passed in the fæces.

In reviewing the last case, the question immediately arises, why was not the amount of cholesterol in the blood even higher, for the jaundice and the diabetes, are, in themselves, accompanied by a hypercholesterinæmia? In attempting to answer that question, the whole subject of the local deposit of cholesterol must be considered. Gall-stones are not the only "local deposits" of cholesterol. In arteriosclerosis and atheroma of the aorta, it has been repeatedly demonstrated that cholesterol is deposited in the walls of the blood-vessel. The yellowish plaques found in the atheromatous aorta are largely composed of cholesterol, and these plaques are not the result of an infiltration, but rather a deposit. The older the process, the greater the deposition, and eventually the vessels become impregnated with lime-salts. It is only in this stage of arteriosclerosis that we

see our apoplexies. And it is during this stage that the cholesterinæmia is not as marked as during the progressive stage. Can we not conclude that the blood-cholesterol is decreased somewhat, because it is slowly becoming deposited elsewhere?

The chronic nephritics, who go on to so-called albuminuric retinitis, also show the effect on the amount of cholesterol in the blood, of the deposition, or, in this case, infiltration of the retinal tissue with cholesterol. It has been shown that the retinal plaques are composed largely of cholesterol, and it has further been shown that cases of nephritis with retinitis, have less cholesterol in the blood than cases of nephritis without retinitis. Can we not again conclude that this diminution is the result of local deposition or infiltration? This same theory I am applying in cases of cholelithiasis. The constant deposition of cholesterol in the gall-bladder in the formation of gall-stones must slowly deprive the blood of some of its cholesterol. Perhaps this would explain some of the comparatively low figures we get despite the presence of gall-stones. This, then, would bring up another point in the proper interpretation of the cholesterinæmia in individual cases. In the last case presented, the patient gave a history of sixteen years. Had we examined her blood ten years ago, the amount of cholesterol in the blood might have been considerably higher than 0.00276 gr. per 1 ccm. A careful history, to determine the onset of the gall-bladder trouble, is, in my opinion, an important element in the interpretation of the cholesterinæmia.

CASE 31 (from the Presbyterian Hospital). Female, age 50 years. Has had five attacks of severe, colicky epigastric pain, radiating to the back, with vomiting and jaundice. Has never had typhoid fever, and has been pregnant nine times. No sclerosis, no fever, no nephritis: very slight icterus. Serum cholesterol amounted to only 0.00177 gr. per 1 ccm. and yet, at operation, the gall-bladder was found full of small stones. In this case we did not obtain a careful history.

CASE 32. Male, age 63 years. Temperature 100° F. Moderate sclerosis, slight jaundice. Urine showed heavy trace of albumin, but no casts. Symptoms and physical signs were all referable to the gall-bladder. Here, again, the comparatively low figure of 0.00214 gr. of cholesterol per 1 ccm. serum was found, and the operation revealed gall-stones. In this case, also, we have no accurate history of the duration of the trouble. In my opinion, we must, in the future, ask ourselves: If this patient has gall-stones, how long has he had them?

CASE 33 (from Presbyterian Hospital). Female, age 42 years. Had been on the Medical Service for two months with a pyelitis when present attack began. Pain and tenderness in right upper abdominal quadrant, with vomiting. Tender mass in the region of the gall-bladder. No jaundice, no sclerosis, no nephritis. Temperature 101° F. White blood-cells, 20,000; polymorphonuclears, 78 per cent. Widal negative. Wassermann negative. Has never had typhoid fever, and has not been pregnant. The blood showed 0.00197 gr. of cholesterol per 1 ccm. serum, an amount which must be looked upon as high in the presence of 101° F. fever. Operation revealed 65 gall-stones, with recently formed layers of cholesterol.

CASE 34 (from Presbyterian Hospital). Female, age 36 years. Onset of trouble six years ago while pregnant the twelfth time. Never had typhoid fever. Temperature 101° F. White blood-cells, 18,000; polymorphonuclears, 86 per cent. Wassermann negative. No jaundice, no sclerosis, no nephritis. Pains in right upper abdominal quadrant simulating gall-stone colic. Serum-cholesterol amounted to 0.00193 gr. per 1 ccm. an amount in favor of cholelithiasis under the circumstances. On operation, a markedly thickened gall-bladder, containing several ounces of pus, and 30 gall-stones were found.

CASE 35 (from Presbyterian Hospital). Female, age 35 years. Three pregnancies, never had typhoid fever. Temperature 100.4° F. No nephritis, no sclerosis, slight icterus. White blood-cells, 10,400; polymorphonuclears, 74 per cent. Wassermann negative. Symptoms strongly suggestive of gall-stone colic. The blood showed 0.00271 gr. cholesterol per 1 ccm. serum. At operation, the gall-bladder was found large and thick, containing 6 ounces of thick viscid bile, and three gall-stones.

CASE 36 (from Presbyterian Hospital). Female, age 38 years. For past six months epigastric pain, vomiting, and for past few days a slight icterus. Has been twice pregnant. No sclerosis, no fever, no nephritis. Definite tenderness in right upper abdominal quadrant where a mass can be felt. Blood showed 0.00256 grams of cholesterol per 1 ccm. serum. Operation showed the cystic and common ducts distended with soft, mushy material, and many small stones.

CASE 37 (from Presbyterian Hospital). Female, age 43 years. History of epigastric pain radiating to back and right scapular region, fever, vomiting. In past five years has had several such attacks. Has never had typhoid fever, has never been pregnant. At present, no jaundice, no fever, no nephritis, no sclerosis. Exquisite tenderness over the gall-bladder and a mass is felt. Cholesterinæmia amounted to 0.00382 gr. per 1 ccm.

serum. Operation revealed a distended gall-bladder, and a pure cholesterol stone impacted in the cystic duct.

CASE 38 (from Presbyterian Hospital). Female, age 50 years. History of pain in right upper quadrant: onset sudden six months ago, with pain in region of gall-bladder. Has had four attacks, and intermittent jaundice. Typhoid fever at 14 years. Seven pregnancies. At present no sclerosis, no fever, no nephritis, but jaundiced. Cholesterinæmia amounted to 0.00321 gr. per 1 ccm. serum. At operation a very interesting condition was found. No gall-bladder was to be found, the only suggestion of it was a small narrow strip of tissue where the gall-bladder should be. The common duct was dilated to the size of a finger. In the lower part of the duct a single oval gall-stone was found. It had a cholesterol nucleus, and a culture from the center of the stone showed bicillus proteus.

These 38 cases presented are sufficient to show that in the great majority of cases, a hypercholesterinæmia accompanies cholelithiasis. It is needless to enumerate more instances. They also show that the cholesterinæmia must be studied in relation to the clinical condition of the patient at the time the blood is examined before it can be properly interpreted and made to assist in deriving at a correct diagnosis. We must make the necessary allowances for the presence or absence of fever, jaundice, nephritis, progressive arteriosclerosis, and must also take into account the duration of the process of deposition in the gall-bladder. These cases further show that a "classical picture" of gall-stones can prove to be a duodenal ulcer, and a "classical picture" of duodenal ulcer can prove to be gall-stones. It is in just such cases, that dependence upon a cholesterol determination, when properly interpreted, will be of great help in making a correct diagnosis, and at times cholesterinæmia has almost shamed the X-ray.

A hypercholesterinæmia, in the absence of arteriosclerosis, jaundice, and nephritis, does not necessarily mean the presence of gall-stones. In my opinion, we must realize that we are dealing with what can be likened to a diathesis, a cholesterol diathesis. This diathesis is either distinctly pathological in that it may result in arteriosclerosis, local or general, or in gall-stones, or it manifests itself as a protective agency as in the infectious diseases and nephritis. Only a careful metabolic study can clear up the many doubtful aspects of the subject of cholesterinæmia.

The following are cases in which the cholesterinæmia was not indicative of the operative findings:

CASE 39 (from Presbyterian Hospital). Female, age 37 years, no fever, no jaundice, no sclerosis, no nephritis. No typhoid fever, and has been pregnant six times. Signs and symptoms referable to the appendix. Blood showed 0.00277 gr. cholesterol per 1 ccm. serum, but at operation a perfectly normal gall-bladder was found. Diagnosis: appendicitis.

CASE 40. Male, age 53 years. No fever, no jaundice, no nephritis, moderate sclerosis. At first symptoms were referable to the right kidney: subsequently, attention was attracted to the gall-bladder. Cholesterinæmia amounted to 0.00330 gr. per 1 ccm. serum, a figure that under the circumstances is suggestive of gall-stones. Operation revealed a perfectly normal gall-bladder, stomach and duodenum. I have no further post-operative record. As for the arteriosclerosis, in this case, I am not willing to state that it alone was responsible for the hypercholesterinæmia.

CASE 41. Female, age 64 years, giving symptoms of gall-stones. No fever, no jaundice, no nephritis. Gastro-intestinal tract negative by X-ray examination. This patient had marked arteriosclerosis. Cholesterinæmia amounted to 0.00310 gr. per 1 ccm. serum, an amount which the sclerosis in this case could account for. The operation revealed intestinal adhesions, and a normal gall-bladder.

These three cases are the only ones in a series of 128 (including the cases presented in the preliminary report on the subject) in which the cholesterol estimation of the blood did not foretell the actual condition eventually found at operation, or the definite diagnosis made on the discharge of the patient from the hospital. And in no case of cholelithiasis, verified by operation, did the blood fail to show a hypercholesterinæmia. Naturally, those cases which showed coincident conditions which influenced the cholesterinæmia, are not included in that statement.

We cannot overlook the interest, and especially the importance of these facts. They prove that a properly interpreted cholesterol determination is of great help, not only in the diagnosis of cholelithiasis, but also in the differential diagnosis of those diseases, which so often simulate cholelithiasis.

DEPARTMENT OF TECHNIQUE

SURGICAL REPLACEMENT OF THE PROLAPSED KIDNEY[1]

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SINCE Hahn's initial effort to save the prolapsed kidney and restore it to its normal place and efficiency, there have been devised many surgical procedures with the same conservative object in view. But the evolution of nephropexy from 1881 has been slow and varied. The original plan, namely, splitting the fatty capsule down to the outer portion of the kidney, stitching this capsule to the wound and packing the wound with carbolized gauze, has been variously modified by those who followed Hahn, but all efforts to permanently fix the kidney were equally unsatisfactory.

Senn in 1897, appreciating the failure of preceding methods, instituted a radical change, namely, the suspension of the organ by means of a strip of gauze passed around the lower pole. In this way he hoped not only to make fixation more certain, but to restore the kidney to its normal position. Deaver and Da Costa modified Senn's method by passing a sling around each pole. Fisher employed two decalcified bone drains and Beyer two rubber drains in the same manner. Chambers in 1901 passed a catgut suture around the lower pole. In some of these procedures the fatty capsule was removed but in none of them was the fibrous capsule utilized directly or indirectly as an extra means of support.

Another important improvement in the technique of fixation was made by Lloyd, who reflected the fibrous capsule of the convex border of the kidney so that the denuded surface might be apposed to the abdominal wall for fixation. To maintain the kidney in position until union took place, Lloyd and some who followed him passed sutures through the kidney substance and both attached and reflected layers of the fibrous capsule. Others utilized the fibrous layers for support by stitching them in the wound.

Previous to October 25, 1907, I employed the technique then in common use, namely, exposing the convex border of the kidney and maintaining the organ in position by means of the sutures passed through the reflected fibrous layers and through tissues in the region of the wound. My results were most discouraging and I became convinced that one of the chief faults in this technique was the failure to maintain the kidney in position long enough for firm union to take place. I reasoned that as the fibrous capsule varied greatly in thickness and strength, it was not dependable and constituted an element of weakness in technique, so that when force from above was directed against the kidney after operation, such as results from vomiting and deep breathing, the sutures might tear through the fibrous layer to which they were attached, and that if we could adopt some method by which the dependence upon this capsule for support could be eliminated, the problem of fixation would approach solution. This reasoning led me to pass about each pole sustaining sutures of chromic catgut. Results of this technique showed me there were a sufficient number of unsatisfactory cases to convince me that the technique failed to meet all conditions. These results proved to me that the convex or outer border was too limited a surface for fixation, and that even though the kidney became attached its position was not always relatively normal and lateral motion was permitted. As the result of such reasoning I adopted a radical change in preparing the kidney for fixation; i.e., exposing the greater part of the posterior surface and using the fibrous capsule to prevent the fat from wedging its way between the apposing surfaces.

Such is a brief résumé of the important steps in the evolution of the method herein advocated.

In discussing the surgical problem of permanent replacement of the prolapsed kidney the approach to the organ demands our first consideration. The posterior or lumbar route is now generally selected, but the technique of approach varies and has not yet been standardized. In the technique of approach which I prefer the initial incision begins over the twelfth rib about five centimeters from the spine, a little above and to

[1]Read before the Medical Society of the County of New York, April 28, 1914.

the inner side of the angle formed by the last rib and the erector spina and extends downward and outward ten or more centimeters to a point near the crest of the ilium immediately above Petit's triangle. The tissues covering the erector spinæ and the latissimus dorsi are dissected from these muscles so as to completely expose them to view. The next incision is made along the line of attachment of the terminal fibers of the latissimus dorsi to the erector spina and lumbar fascia and this portion of the latissimus dorsi is freed and transferred to the outer margin of the wound. The lumbar fascia, or strictly, the transversalis aponeurosis is completely exposed when the lumbar portion of the latissimus dorsi is thus transferred to the outer margin of the wound. The lumbar fascia is now incised at its upper portion or superior triangle immediately below and parallel to the twelfth rib. This incision is extended as necessity demands. The lower area of the transversalis portion of the intra-abdominal fascia is thus exposed, where it divides to form the fascial capsule of the kidney, and the last dorsal nerve is seen following close to and parallel with the inner margin of incision.

In the upper angle of the lumbar fascial incision the retrorenal or posterior layer of the fascial capsule is seen and incision of its posterior layer exposes the fatty capsule, through which the kidney is directly approached by blunt dissection. The fatty capsule is now separated by the finger from its attachment to the kidney, excepting about the poles where the finger is hooked into the remaining tissue of the capsule and one or the other pole directed toward the wound. When the kidney is delivered the remaining attached portion of the fatty capsule is freed and both kidney and ureter examined carefully.

A crescentic incision of the fibrous capsule is now made. This incision begins practically on the convex surface near the upper pole, extends on the posterior surface of the kidney to within about one centimeter of the hilum, and continues to the convex surface near the lower pole. Two sustaining sutures of silkworm gut, kangaroo tendon, or chromic gut are now passed completely around the kidney, one about the lower and one about the upper pole. They are passed in the following way: The one surrounding the lower pole penetrates first the free portion of the fibrous capsule near its juncture with the kidney and about one-half inch from the center of the convex border. In its course around the kidney it penetrates the anterior surface of the fibrous capsule midway but only sufficiently to keep it in place. It is now passed around the inner or concave border close to the lower limits of the hilum and then through the attached portions of the fibrous capsule remaining on the posterior surface. The suture encircling the upper portion is passed in like manner and the ends of these sutures are clamped to keep them in position until the kidney is replaced. Three or more small catgut sutures penetrate the margin of the freed fibrous capsule. These are used after the kidney is returned to anchor this portion of the capsule to the under surface of the lumbar fascia.

None of the fatty capsule except such as may remain attached to the lumbar muscular area is removed. As a rule all of the fatty capsule is forced below and in front of the kidney when the organ is replaced, where it is retained by the anchored fibrous capsule. The inner ends of the sustaining sutures are now passed in the upper angle of the wound through the lumbar muscles penetrating them well to the inner side of the last dorsal nerve and out through the skin. The outer ends are passed through the muscular tissue immediately below the twelfth rib and out through the skin. The several catgut sutures which are attached to the margin of the freed fibrous capsule are now anchored to the under surface of the lumbar fascia near its cut edges. The freed fibrous capsule being thus anchored to the under surface of the fascia acts like a shield to prevent the fat in the immediate region from being forced between the posterior surface of the kidney and the quadratus lumborum.

The fascial or aponeurotic incision is now closed with No. 1 or No. 2 plain catgut sutures, care being taken to avoid the last dorsal nerve which can be plainly seen crossing the inner margin of the wound. One or two interrupted catgut sutures may be necessary to approximate the fibers of the transversalis and internal oblique muscles. The latissimus dorsi is now returned to its position and its cut edges sutured to its original line of attachment with a continuous plain catgut suture No. 1 or No. 2. The subcutaneous structures are approximated by one or two interrupted catgut sutures and the skin edges united by any method preferred. The sustaining sutures at the upper angle of the wound are tied over a small roll of iodoform gauze, the lower suture being tied first so as to elevate the kidney as much as possible. If kangaroo tendon or chromic gut be used for the sustaining sutures, they can be brought out through the skin or not as desired by the operator.

Post-operative care extends over three weeks. In dressing the wound, care should be taken not

to restrict the motion of the chest or abdomen. It is usually not necessary to redress the wound until the seventh day. The skin sutures are removed on or after the twelfth day. The silkworm-gut sutures are cut to the inner side of the loop on the nineteenth day and the patient allowed to get out of bed and sit in a chair. This is more advantageous and comfortable than sitting with the limbs extended in bed, as the abdominal contents are less crowded. She is encouraged to walk on the following day and on the twenty-first, the silkworm-gut sutures are gently pulled upon. If they do not come away easily, force is not used. The patient is encouraged to walk about and gentle traction is again made on them in a day or two.

The severing of the terminal fibers of the latissimus dorsi along their attachment to the erector spinæ and the lumbar fascia, and the transferring of the lumbar portion of this muscle to the outer boundary of the wound permit of a complete exposure and easy access to the upper portion of the lumbar fascia or superior triangle. This temporary removal of the muscle from the direct line of approach to the kidney not only facilitates deep manipulation but affords an opportunity for the selection of the direction of the fascial incision. The latissimus dorsi is usually larger on the right side than on the left, owing to the fact that most people are right-handed. When this muscle is not well developed, considerable care must be used in severing its fibers near their lumbar attachment so as not to open the sheath of the erector spinæ nor cut the lumbar fascia immediately below. The fibers of this muscle in the lumbar region are usually attached in greater part to the sheath of the erector spina, but it occasionally happens that its lower one-half or more is attached to the lumbar fascia only, thus leaving a considerable part of this fascia uncovered by muscle. When the lumbar fascia is incised in the general direction of the erector spina, as is commonly done, the nerves and blood-vessels which lie immediately below and which run nearly at right angles to the incision are necessarily subjected to great risk of injury; but when the fascia is incised immediately below and parallel to the last rib, we approach the deeper structures of the outer side of the last dorsal nerve. This nerve follows closely the lower border of the twelfth rib for a short distance, then changes its direction slightly. Its average distance from the rib in the lumbar fascial region is about one centimeter. The nerve is easily located under the fascia on the inner side of the incision and close to its edge, and as its divergence is in the general direction of the pelvis, a continuation of the incision outward into the transversalis and internal oblique muscles can be made to any required extent without fear of injury to it unless there exists an abnormality. If it is desired to enlarge the incision inward the lower border of the rib must be followed closely.

During operation, the nerve is practically always within view and easily avoided when passing the silkworm-gut sutures through the muscles and when closing the fascial incision. Exceptions to this course of the nerve may be met with, that is, the nerve may follow closely the twelfth rib its entire length, necessitating great care in avoiding it when enlarging the incision and when passing sutures through the outer portion of the wound. I have encountered this abnormality twice. The importance of avoiding the nerve cannot be overestimated, as injury to it is often responsible for painful sequelæ. The last dorsal, the iliohypogastric, and the ilio-inguinal nerves are encountered in most methods of approach, increasing thereby the chances of nerve injury. Post-operative pain and diasthesia along the iliohypogastric nerve in the gluteal region, pain in the outer side of the thigh and hyperæsthesia along the course of the iliohypogastric nerve have been frequently observed following the technique of approach through the lumbar fascia at a right angle to the general direction of the nerves of that region, and therefore constituting a serious objection to this method of approach. Since adopting the present technique of approach post-operative nerve symptoms have been materially lessened.

The only arteries of any size encountered in this technique are sufficiently small to be controlled by forceps pressure and are encountered usually when in the lower angle of the wound, as the aponeurotic or terminal fibers of the latissimus dorsi are severed, and the other in the upper angle of the fascial incision when the incision is extended to involve the lower digitation of the serratus posticus inferior.

On replacing the kidney the posterior portion of the fatty capsule is removed if any of it remains attached to the lumbar muscular area, as its presence there will interfere with the proper apposition and union of the surfaces to be apposed. The remaining portion of the fatty capsule is forced anterior to the kidney and maintained there until the fibrous capsular flap is anchored to the under surface of the lumbar fascia. The fat is in this way prevented from wedging between the kidney and the lumbar area

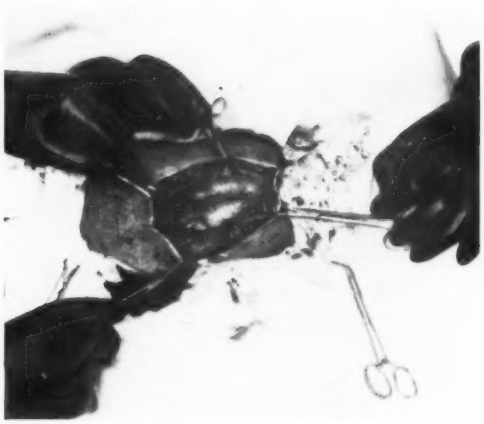

Fig. 1. The erector spinæ and latissimus dorsi are shown at the bottom of the wound. The lumbar fibers of the latissimus dorsi are, in the second step of the operation, severed along their attachment to the erector spinæ, freed from the lumbar fascia, and transferred to the outer margin of the wound.

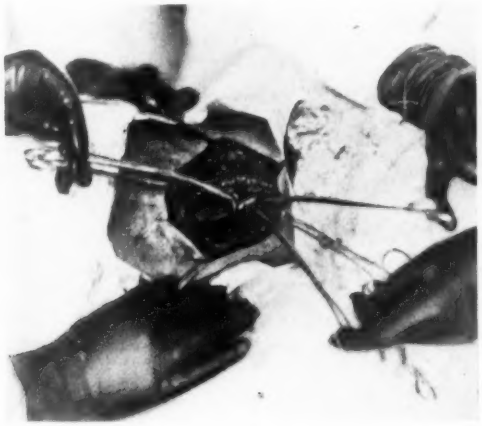

Fig. 2. The initial incision of the lumbar fascia in the superior triangle immediately under and parallel to the lower border of the last rib.

to which it is to be fixed. When the denuded posterior surface of the kidney is in this manner apposed to the aponeurotic covering of the quadratus lumborum and union between them takes place, there is established a condition of the kidney closely approaching normal; namely, stability with limited mobility.

By following the technique herein described, the possibility of injury to the last dorsal nerve and its blood-vessels is eliminated, unless their location is abnormal, and even then by careful manipulation serious injury can be avoided. Opening into the peritoneal cavity is impossible, excepting when the liver or spleen is prolapsed and mistaken for the kidney. In passing the sustaining sutures about the poles, care should be taken to discover and avoid the ureter and the renal vessels. In delivering the kidney from the wound we sometimes encounter an accessory artery passing through the fatty capsule and entering the kidney usually near one of its poles. This is recognized first by the greater resistance it offers as compared to that offered by the fatty capsule alone, and also by its pulsation. The artery should be secured by a forceps before further attempt is made to deliver the kidney. With ordinary surgical care the delivery, *per se*, should entail no danger.

It possesses the advantage of permitting a thorough preparation of the kidney and allows a complete examination of the organ and upper urinary tract and affords an easy approach through the pelvis of the ureter for the removal of calculi, if such a complication be discovered.

In replacing the kidney the lower portion should as a rule be returned first. If difficulty be met with, it is usually due to the intra-abdominal fascia offering an additional obstruction at the lower angle of the wound. To facilitate replacement this fascia may be further incised or retracted. Usually it is only necessary to grasp the cut edges of the fascia with a forceps in the angle and gently force the pole through the fascial incision.

Though the anatomy of the lumbar region is familiar to every surgeon, the functions of the structures about the kidney with respect to the support and mobility of the organ are yet in dispute. The kidney is afforded its chief protection from external influences by the spinal column, the great back muscles and the lower ribs. Within their boundaries there is a well-defined fossa in which the kidney rests. This fossa varies in depth with the sex and in different individuals of the same sex. Any influence which restricts the free motion of the upper abdominal and lumbar regions, as for instance tight lacing, tends to force the kidney out of the fossa and subject it to the depressing influence of force from above. The fossa is therefore an indirect factor in the maintenance of position. The kidney has no ligaments, strictly speaking, but is completely surrounded by a strong fascial structure. This fascial structure or capsule is but a part of

Fig. 3. The fascial incision extended involving in the lower angle, the internal oblique and transversalis muscles.

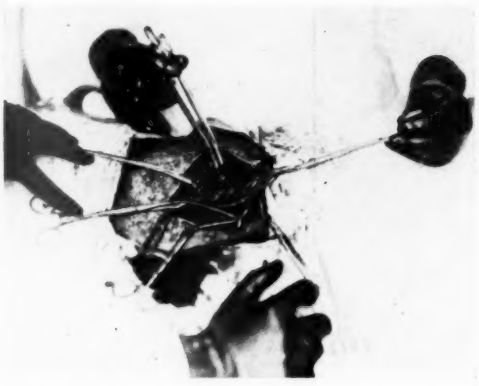

Fig. 4. The fatty capsule open, kidney seen at the bottom of the wound. (Photograph unsuccessfully retouched.)

the great intra-abdominal fascial system, which is so wonderfully arranged as to render vital support to practically every abdominal organ and out of which most of the so-called ligaments of the abdominal viscera are formed. The renal arteries and veins render no support while the kidney is in normal position. These vessels support the kidney and restrict its mobility only when it is forced beyond its normal range of motion, which motion does not exceed in any direction, three centimeters.

The fascial capsule or perirenal fascia is composed of a posterior and anterior layer. Superiorally and outwardly these fascial layers are continuous; inferiorally and inwardly they do not blend and can be easily separated by blunt dissection. Inwardly they surround the renal vessels as far as the spine, where the posterior layer terminates and is attached and the anterior layer blends with the corresponding layer of the opposite side. Inferiorally they surround the ureter and their failure to unite in this direction constitutes an essential weakness in the scheme of renal support. The posterior layer, also called the retrorenal fascia, is intimately attached to the fibrous arches for the psoas and quadratus lumborum to the twelfth rib in this immediate vicinity, the first and second lumbar vertebræ and the diaphragm. As the upper and outer portions of the anterior layer are continuous with the corresponding portions of the posterior layer, and the posterior layer is fixed to stable points of the anatomy, the stability of the anterior layer is greatly dependent upon the fixity of the posterior layer, constituting a most important factor in renal support.

Between the kidney and the fascial capsule there is a network of areolar tissue in the meshes of which is deposited fat, constituting the tunica adiposa. This so-called fatty capsule renders support to the kidney to which it is attached only as it is in turn supported by the fascial capsule to which it is also attached. The fatty capsule renders support to the kidney only within the limits of the fascial capsule, that is, if the fascial capsule were detached from its fixed points of support, the kidney with its capsules would prolapse and be limited in descent or motion by the resistance of the renal vessels alone; but if the fascial capsule remains fixed and the tunica adiposa be completely severed from its attachment to the kidney, the kidney would then prolapse within the limits of the fascial capsule.

Morris cites that "in the infant the fatty capsule does not exist and it is the peritoneum which is the chief agent giving fixture to the kidney." The conclusion to be drawn here is that with or without the fatty capsule the peritoneum is an important factor in supporting the kidney. To my mind, the resistance afforded by the peritoneum, *per se*, and the support it renders the kidney in infant or adult is practically inconsiderable. The peritoneum is attached to the intra-abdominal fascia from which is formed the fascial capsule, and its stability is dependent upon the stability of this fascial capsule.

Edebohl remarks that "in the early operations of nephropexy . . . the idea dominated that the kidney ought to be anchored as high up as possible

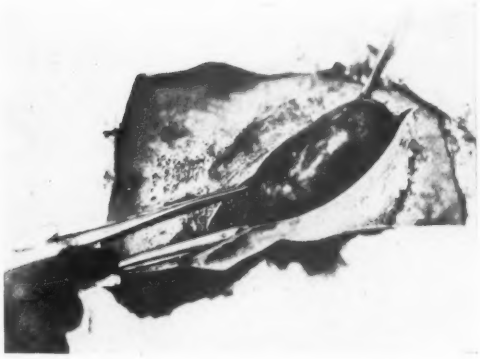

Fig. 5. The kidney delivered and free of its fatty capsule which has been forced into the wound anteriorly. (The convex border is presented.

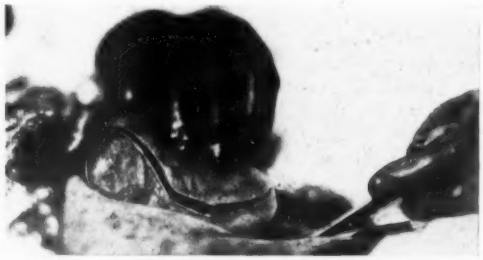

Fig. 6. A crescentic incision of the fibrous capsule on the posterior surface of the kidney extending from pole to pole and to within one centimeter of the hilum.

under the ribs. The fact was not sufficiently recognized and appreciated that it is the mobility of the kidney which gives rise to the symptoms, and that the latter will be perfectly relieved by anchorage of the loose organ even at some distance from its normal habitat. The attempt to realize the ideal inspired the practice of anchoring more or less of the lower end of the kidney only, leaving the untouched pole to project upward beneath the ribs. This leads in many cases to either anteversion of the upper pole or to the crowding down of the kidney and often resulting in the return of the old symptoms." Again he states that "the kidney cannot be fixed in its normal position and should be fixed squarely in the loin. . . . The middle part fills the lumbar spaces, the upper part projecting as far upward beneath the rib as the lower pole reaches downward below the level of the crest of the ilium."

The practical results of the technique that I follow, as well as experimentation upon the cadaver, have demonstrated that the kidney can, by surgical means, be placed in the immediate region of its normal habitat, the only exception being when the liver or spleen are also considerably prolapsed and enlarged, for by occupying the kidney region they crowd the organ and may prevent it from assuming its normal position. With no obstruction in the upper lumbar region the elevation of the entire organ is ensured by tying the suture encircling the lower pole first. The tying of the upper suture next ensures the position of the upper pole and the mobility of the organ.

When the sheath of the quadratus lumborum is opened its entire extent and the muscular fibrous layer laid bare, as advised by Edebohl, it is difficult to prevent injury to the nerves and blood-bessels of this region, for they pass immediately in front of the muscle; fixation of the kidney to the muscle causes an abnormal relationship and every motion of the muscle imparts motion to the kidney and every force acting on the kidney must act correspondingly on the muscle. The functions of the nerves and vessels are likewise frequently interfered with by such intimate and abnormal fixation, but union of the kidney to the fascial and aponeurotic structures covering the quadratus lumborum would in no way interfere with functioning of the muscle, nerves, or blood-vessels. The only preparation of the muscle area in the technique which I advocated is the removal of the retrorenal fat, if any remain attached to this area.

According to Edebohl, "the broader the surface for union . . . the stronger will be the anchorage." He in common with all others aimed to fix the outer or convex surface of the kidney to the anterior plane of the quadratus lumborum. In so doing he made an extensive denudation of the kidney surface, but this stripping back of the capsule beyond the limits of the convex surface does not increase the area to be apposed for fixation. In width this surface is usually no more than two and one-half centimeters, and because of its considerable convexity its middle one-third only can be well apposed to the flat surface of the muscle. The posterior surface of the kidney presents the least convexity and greatest expanse for apposition and if the question of permanent anchorage resolves itself into the question of the extent of the surfaces apposed, there is left no room for argument as to which surface of the kidney is the surface of choice.

Another objection to fixing the kidney by its

Fig. 7. Three No. O chromic catgut sutures penetrate the margin of the freed portion of the fibrous capsule. After the kidney is replaced these sutures are used to anchor this fibrous flap to the under surface of the lumbar fascia, where it acts as a shield to prevent the fat from entering between the kidney and the quadratus lumborum.

convex surface is that when so fixed the hilum is forced forward and out of its normal and anatomical relationship. However, when the posterior surface, which is slightly convex, is apposed to the concavity of the lumbar region, the hilum is directed inward and its anatomical relationship restored. Resting thus on its posterior surface, the kidney occupies less space anteroposteriorly than when fixed by its outer surface, and assuming thus a protected position in the lumbar fossa according to Nature's plan, escapes force from above, as when a coin placed in the palm of the hand escapes the influence of a brush passed over it.

The principles of nephropexy advocated by Billington are open to several objections. The suspension is made in part through a flap of the fibrous capsule stripped from the upper half of the convex and posterior surface. Additional support is rendered by two Brodel sustaining sutures inserted in the attached fibrous capsule, covering the lower one-half of the convex surface. The fibrous flap, the base of which is attached to and crosses the center of the convex surface is passed up and out between the eleventh and the twelfth ribs and attached to the lips of the fascial incision. The Brodel sutures are tied first, being inserted in the attached portion of the fibrous capsule on the lower half of the convex surface direct and fix this area to the posterior wall. The position occupied by the kidney when

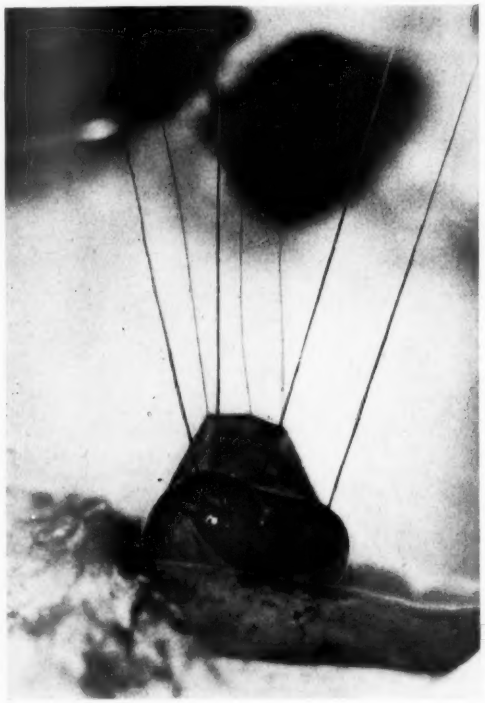

Fig. 8. The two sustaining silkworm-gut sutures are here shown encircling the kidney; also the three fibrous capsule sutures.

so suspended is on a line external to the outer margin of the erector spina and the middle of the convex border is on a level with the twelfth rib, while the hilum is directed forward. This position of the kidney is not normal and the organ becomes to a dangerous degree exposed to force from above. In Billington's technique no provision is made to support or even limit the motion of the upper pole, so that this pole is free to move in whatever direction influenced. Under these circumstances a displacement of the upper pole is always possible when vomiting or coughing are severe and persistent. The organ is therefore liable to topple over or antevert and produce a twisting of its pedicle. Also when the liver is enlarged or is prolapsed much below the twelfth rib, it is practically impossible to adopt Billington's technique.

The technique advocated by Longyear fails also to ensure the normal replacement of the kidney, and as the position of its upper pole is not

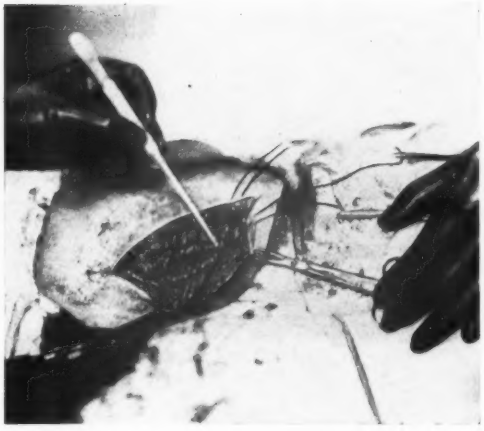

Fig. 9. The lumbar fascial incision closed. The sustaining silkworm-gut sutures have penetrated the muscles and skin and are seen emerging near the upper angle of the skin incision. (Photo retouched but unsatisfactorily.)

Fig. 10. The wound closed and the silkworm-gut sustaining suture tied over a roll of iodoform gauze.

ensured the kidney may likewise antevert and produce a twisting of its pedicle. Longyear's technique possesses one possible advantage and that only when the anterior layer of the fascial capsule has been considerably stretched by the prolapsed kidney, his technique fixes the cellular structure, termed by him a renocolic ligament, which connects the lower anterior surface of the kidney with the anterior layer of the fascial capsule, to which on its peritoneal side is usually attached the colon, and in so doing may elevate to some extent the colon. But the cellular structure of the fatty capsule is a structure of little resistance and the permanency of the apposition may be considered doubtful if it is dependent upon this structure. The area of the anterior layer of the fascial capsule to which the colon is attached is located near the spine, and as this layer of fascial capsule blends with the corresponding layer of the opposite side and is attached to the tissues of the spine, it is rendered more stable than the middle portion. In prolapse of the kidney it is usually the middle portion of the anterior fascial layer which yields. Cases are not uncommon, however, where the prolapsed organ follows the line of fascial cleavage in the direction of the ureter, where the failure of the layers to fuse constitutes a weakness in Nature's scheme of kidney support.

When the kidney is fixed by the technique which I advocate, the constant pressure on the anterior layer of the fascial capsule is relieved. The released fatty capsule placed anteriorly must again attach itself somewhere and can attach itself nowhere but to the stable kidney. The overstretched fascial capsule, relieved of the weight of the kidney, returns to its normal condition and position. If, however, it is considered necessary or desirable to fix the lower cellular tissues, which are indirectly connected, to the colon, it can be accomplished during the operation by passing one or more sutures through it and anchoring them to the lumbar fascia when closing the fascial incision.

SUTURE MATERIAL

I prefer the use of the silkworm-gut as a sustaining suture to chromic gut or kangaroo tendon, because the power is constant, while that of the absorbable diminishes in strength daily. With the use of the silkworm-gut, the maintenance of the kidney where placed is ensured until sufficient time has elapsed for strong union of the surfaces apposed. With the use of the absorbable materials there is no certainty of this apposition remaining when force is exerted from above, such as may be caused by deep breathing, persistent coughing or vomiting.

The objection has been made to silkworm-gut that it is likely to cut the kidney surface. This objection is only theoretical, as in my experience such has never occurred. The sustaining sutures do not touch the kidney proper, it being protected by the attached portion of the fibrous capsule on its entire surface. It is necessary that the silkworm-gut sutures be carefully selected and that they be of large size and smooth, as points of

roughness make their removal difficult. Such an experience I have met with twice; in each instance great care and patience had to be exerted. In one of these cases more than a week of gentle traction daily was required and on removal of the gut it was discovered that extensive corrosion at several points had taken place. The black dyed is not desirable as it is friable. Plain or vegetable dyed is to be preferred.[1]

The arguments advanced in favor of silkworm-gut apply equally to silver wire; the latter possesses the additional advantage, however, of never becoming rough. The chief objections to its use are that it is not always conveniently obtained and that if the loop has in it a kink, the removal of the suture may be difficult and painful.

The absorbable sutures are less objectionable as sustaining sutures if they are brought out of the body and tied over a roll of iodoform gauze as is done with the non-absorbable. By this technique the burying of the knot in the tissue is avoided; Nature is usually capable of contending with these knots, but she sometimes fails.

DRAINAGE

Drainage is never necessary excepting perhaps where a stone is removed at the time of nephropexy. If a stone be removed from an incision in the pelvis of the ureter, the direction of the drain should be from the area between the pelvis of the ureter and the muscles of the back along the lower pole and through the lower angle of the lumbar fascial incision. It should then penetrate the fibers of the latissimus dorsi immediately above and pass out through the corresponding opening in the skin. If the stone be removed through an incision in the cortex, the drain is in the same direction as described, but leads from the convex border only. When the cortex is cut in removing a stone, the sutures encircling the kidney assist materially in apposing the cut surfaces and in checking hæmorrhage.

In both pyelotomy and nephrotomy, nephropexy should at the same time be done. This can be best accomplished by the technique here advocated because in so doing the kidney is suspended at its greatest possible elevation and consequently thorough drainage is ensured to the distended pelvis or pus cavities.

[1] Flexible silkworm-gut has been tried but without satisfaction, as the tissues become entangled in its fibers and render its removal difficut.

SUMMARY

1. This approach to the kidney necessitates the least injury to the tissues encountered and facilitates deep manipulation.

2. In closing the wound only a minimum amount of the simplest suture material is required and the replacement of the tissues is absolutely anatomical.

3. The kidney area exposed for attachment is the most extensive surface available and so situated as to permit the kidney being anchored in normal, anatomical relationship.

4. The sustaining sutures encircling both poles ensure immobility until firm union has taken place and their high placement in the tissues of the back ensures a practically normal position of the organ.

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A METHOD FOR PREVENTING AND CONTROLLING HÆMORRHAGE FOLLOWING PROSTATECTOMY

By L. H. COOK, M.D., Bluffton, Indiana

PROSTATECTOMY may not be followed by severe hæmorrhage; bleeding may be slight or severe, and readily controlled by one of the various procedures ordinarily applied. But in some instances it may be alarming especially in the aged when the loss of blood and the accompanying shock greatly lessen the chances for recovery. In addition to the means that have been suggested and already applied, the following device seems to me to possess advantages that would be of value when hæmorrhage becomes severe or difficult to control.

A catheter of good size is passed into the bladder and drawn out through the opening at the fundus, a strip of gauze about one and one-half inches in width and of sufficient length as may be required to make a pack approximating the size of space to be packed is wrapped around and above the opening of the catheter by two or three stitches coming out at the side of the catheter over the gauze and tied, the first knot being drawn down snugly to the gauze. Before tying the second knot a thread of sufficient length to be drawn out of the bladder wound along with the end of gauze strip, is placed over the first knot when the second knot is tied. The thread making the tie is then cut close to the knot. Two or three such threads are placed, each long thread and strip of gauze is held, when the catheter with the ring of gauze pack is drawn into the bladder down to the bleeding area, sufficient traction being made to secure coaptation of the denuded surfaces thus obliterating the space occupied by the prostate. When the danger from hæmorrhage has subsided traction is made upon each thread, thereby releasing the second knot. Traction upon the protruding end of the gauze releases the first knot and unwinds it from the catheter permitting its easy withdrawal from the bladder. The drainage or irrigating tube is placed to be removed when desired.

The gauze pack applied in the manner described not only serves in controlling and preventing dangerous hæmorrhage, but also serves to replace the torn and overlapping bladder-wall, holding the denuded surfaces in place, an aid to early union of the parts separated by the operation, rendering unnecessary the frequent hot water irrigation used by some operators, a means of controlling hæmorrhage that is not only painful to the patient but adds to shock from frequent disturbance.

A "PAINT BRUSH" DRAINAGE TUBE

By A. MERRILL MILLER, M.D., F.A.C.S., Danville, Illinois

FOR some time past the split rubber tube has found favor for use in cases requiring drainage.

The objection to its use in the abdominal cavity is the danger of necrosis of soft tissues by the hard unyielding end. To overcome this objection and retain the advantage of the tube, I use a tube splitting the entire circumference an inch or more in its long axis. The small rubber

terminals thus made will not cause pressure necrosis and will readily adapt themselves to changing positions of the abdominal viscera (see illustration).

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

By MAJOR G. SEELIG, M.D., St. Louis

THERE is something subtly deadening in reading with the fixed purpose of criticising—something that is not categorically different from the state of mind of the modiste as she surveys the new spring styles. If one cannot successfully lose the thought that he is a critic, he finds himself inevitably snared in a maze of data, which, though jotted down purely for purposes of criticism, confuses his sense of appreciation and clear reasoning. This is particularly true of medical books. Medical theory and practice is in a state of constant flux; there is so very little that may be expressed in warrantably *ex cathedra* fashion, and by contrast, so very much that is promulgated with the seal of authority affixed that one subconsciously finds himself holding his mind open to mere details, worthy or unworthy, upon which to rest his criticism.

On the other hand, if one reads for the simple joy of reading, unmindful of opinions that may be crystallizing in his own mind as he reads, he finds that each volume makes a totality of appeal to his judgment. He sees and feels what he otherwise would have failed to see and feel. Good reading, like good painting, should be done with the thought of perspective and proportion always in mind.

There is a central idea of purpose in practically every volume published. The art of the critic lies in furnishing sane comment on this purpose, or in pointing out the failure or success of the author in making his purpose clear. Of course, in doing this, details must neither be elided nor lost sight of; the reviewer should bear in mind merely that if he dissociates himself from the large purpose of the book, and centers his critical attention unduly on details, he will too often find himself not seeing the forest for the trees.

Let us go through the books of the month with the notion in mind of the impelling motive that is responsible for each volume. Whatever there may be said regarding the value of this type of critique, no one may say that it is lacking in interest.

THIS volume on *Autoplastic Bone Surgery*[1] illustrates most admirably exactly what we mean by the phrase "central idea of purpose." One does not need the statement in the preface of the book to convince him that the authors have had their interest awakened from three different directions: experimental, bibliographic, and clinical. There are no concrete statements in the text emphasizing the fact, but one knows, nevertheless, that the authors felt the inner drive to aid in clarifying a surgical topic that is just now in process of evolution. Such a purpose is worthy, and it is gratifying to be able to note that accomplishment has kept pace fairly well with purpose.

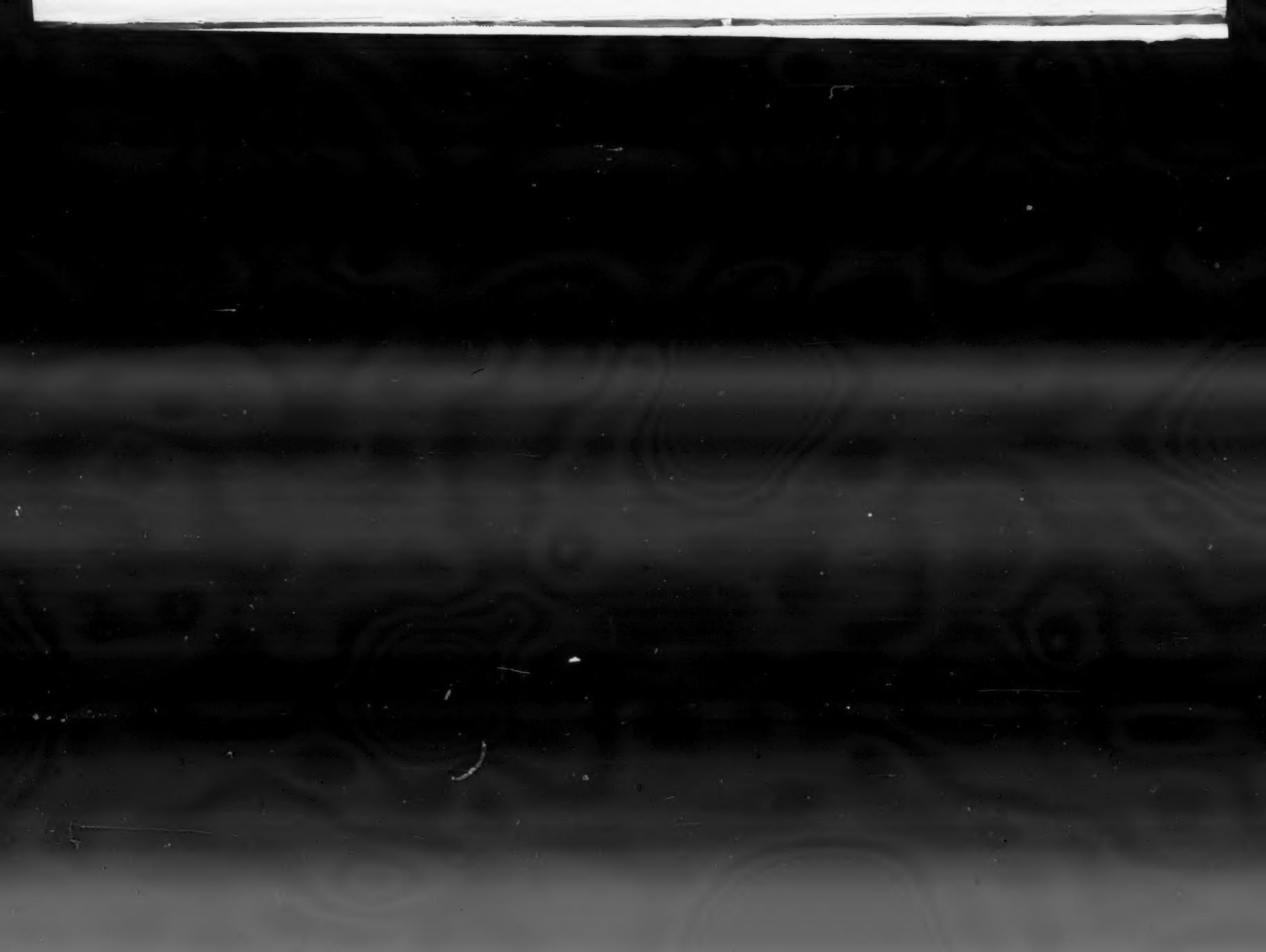
The book does not differ markedly from its sister volume written almost synchronously by Albee, and recently reviewed in these columns. A careful survey shows that in spite of a different arrangement of chapter heads, the same subjects are treated in much the same fashion, with the normal diversity of opinions that one would expect to meet in a moot subject of this type. The general topics of bone transplantation, periosteal regeneration, indications and technique, autoplastic repair of fractures, arthroplasty, autoplastic immobilization of spondylitis and of congenital bone defects are all accorded due space. The chapters on periosteal regeneration of bone, and regeneration of bone are written with almost didactic clearness, each chapter ending with a clear, crisp summary of the fundamental facts. It is interesting to note that the indications for bone grafting furnished by Davison and Smith tally almost to the letter with the indications set by Albee. One is also struck by the fact that these authors have seen the wisdom of doing what Albee failed to do; namely, appending what seems to be a very full and accurate bibliography.

Anyone who has followed this new chapter of bone surgery closely, mindful of the great diversity of opinion so noticeable since the publication of Macewen's book, *Growth of Bone*, will naturally hesitate to take sides with or against the authors on any doubtful question. The thing of significance and interest is that the purpose back of the book has resulted in furnishing us with a work of practical importance, from the academic as well as from the purely technical point of view. We have said before, in these pages, that the good monograph is the lodestone of the library. This volume serves to strengthen that opinion.

THIS next book by Dr. Crile[2] has in some inexplicable way reached the reviewer's sanctum about one year late. The delay is in a

[1] Autoplastic Bone Surgery. By Charles Davison, M.D., and Franklin D. Smith, M.D. Philadelphia and New York: Lea and Febiger, 1916.

[2] Anoci-Association. By George W. Crile, M.D., and William E. Lower, M.D. Philadelphia and London: W. B. Saunders Company, 1915.



sense fortuitous, for had the book reached us on schedule time, we would have felt obliged to paraphrase the doctrine of anoci-association, comment on its scientific basis, dilate upon the weakness and strength of Crile's methods, in short, fuse the new doctrine in the crucible of criticism. Now, fortunately, all this has been done for us. It is pretty safe to assume that those who do not feel what William James used to call the sense of personal warmth of knowledge of the anoci-association theory, do not read SURGERY, GYNECOLOGY AND OBSTETRICS. We are free therefore to play with the thesis of the month, and content ourselves solely with interpreting the purpose back of Crile's work.

And lest our judgment appear colorless and ultrajudicious, it is necessary to say at the outset that we feel that the recent severe criticism of anoci-association by Carlson, even though it took on somewhat the form of a polemic, was in good part justified. This is unfortunate, and equally unfortunate is the fact that many of Crile's conclusions do not flow from well-constructed syllogisms, but seem to be revelational.

If one dismisses, for the time being, all such broad generalizations as the above, he unavoidably centers on the "drive" back of the work, the enthusiastic, determined effort to popularize a doctrine. And however much one may take issue with the so-called pure science of the work, or however spiritedly he may cavil at the all too comprehensiveness of Crile's inductions, he must nevertheless feel the weight of sincere effort represented by the large amount of experimental data collected over a long period of time.

The presentation of this mass of experimental data marks only one-half of the purpose of the book—it stands as the academic purpose. Much more important are the advantages that have accrued to surgery. These latter results constitute the practical workaday purpose of the doctrine. Beyond all question of doubt, Crile has ingrained a spirit of surgical gentleness in the consciousness of countless surgeons. Careful selection of operative material, gentleness of manner, deliberate and thoughtful precision of act, closely correlated fusion of individual efforts—these are things that have resulted directly from Crile's magnetic words written and spoken, and I, for one, am content to let such things tip the balance against the load of somewhat faulty logic. In other words, I am inclined to pass over the conflict of testimony and to experience a deep sense of gratitude for what the doctrine of anoci-association has done for surgery, from the crass practical point of view.

IN this volume Smithies[1] has collected the largest amount of clinical data covering the greatest number of intensively studied stomach cancers that I have ever seen grouped between two covers. In reality the book comes under the head of monographs, but bulk, form, thoroughness and wealth of illustrations force one to group it under the head of treatises.

The plan of the book, excellent throughout, rests on a carefully developed chapter division of twelve parts. Each chapter in its turn is based upon the personal experience of the author, and then rounded out by a critical selection from literature of data bearing on the various important topics discussed. It is impossible to overestimate the value of this method of exposition. For example, in Chapter XIII, on Gastric Cancer in the Young, Smithies not only analyzes, in minute detail, eighteen such cases of carcinoma studied by him, but also furnishes his reader with the references necessary for a broad conception of this most interesting though limited topic (Welch, Osler, McCrae, and Dock).

Chapter I, General Distribution and Etiology, furnishes nothing new, but merely presents, in rather extended fashion, much valuable data collected from various accredited sources. Chapter II, on Morbid Anatomy, is notable chiefly for the large amount of pathological material, and the care with which it has been studied. Excellent and painstaking as has been the work of MacCarty, it hardly justifies Smithies statement that to it "we owe practically all our useful knowledge regarding the early histologic changes which are associated with the development of gastric cancer." The notable point in Chapter III, Symptomatology, is the radical, and yet rational (though we must concede Utopian) hope expressed by the author, that the early diagnosis of cancer of the stomach must be made microscopically from a bit of freshly removed tissue. This chapter is particularly full, embracing as it does quite a number of illustrative case histories. Chapter IV deals with physical signs, under the questionable title of "Physical Abnormalities." In this chapter Smithies very wisely dilates upon those signs (he enumerates seven of them) which determine the inoperability of gastric malignant neoplasms. Chapters V, VI, and VII deal in order with the clinical microscopy of gastro-intestinal function, roentgen examination, and blood changes in gastric carcinoma. That portion devoted to roentgen examination is only fairly well illustrated; the plates are by no means as good as the recently published ones in the work of George and Leonard. It is necessary to emphasize this fact, because a poor reproduction of an X-ray plate is worse than useless. Chapter VIII, the Significance of Gastric Ulcer with Respect to Gastric Cancer, suffers somewhat by reason of its highly statistical character. We should have preferred a more condensed and concentrated arrangement of the statistics, followed by a more distinctly personal statement by the author of his own interpretation of the figures. Chapter X, Differential Diagnosis, is the weakest chapter of the book. No further

[1]CANCER OF THE STOMACH: A CLINICAL STUDY of 921 OPERATIVELY AND PATHOLOGICALLY DEMONSTRATED CASES. By Frank Smithies, M.D. With a Chapter on the Surgical Treatment of Gastric Cancer, by Albert J. Ochsner, M.D., L.L.D., F.A.C.S. Philadelphia and London: W. B. Saunders Company, 1916.

support of this criticism is necessary than the mere mention that Smithies does not even suggest pernicious anæmia or tuberculosis in any of his differentiations. If one calls to mind the chapter on differential diagnosis in Schmidt's book on *Tumors of the Abdominal Viscera*, he will at once appreciate how far short Smithies has fallen. The final chapter on the non-surgical treatment of cancer of the stomach is admirably done and constitutes a most valuable part of the volume. It is unfortunate that Smithies, in describing the technique of transfusion in inoperable cases, describes the method as the "Percy-Cook method." The credit should go to Kimpton, to whom it properly belongs. The chapter on the surgery of gastric cancer, written by Dr. Ochsner, is adequate and particularly well illustrated. One misses, with regret, any mention of the recently proposed Polya method of gastric resection. Comment on this operation by Ochsner would have been particularly valuable.

On the whole, the book fulfills its purpose well in demonstrating the value of an intensive, well correlated study of clinical material. The only thing lacking is just a bit more of Smithies himself, for the sake of color and interest. A strongly personal note adds conviction as well as salt and spice to a book. On pages 167 and 168 the author rises in righteous wrath against the "fox trot," "bunny-hug," corsets, *et al*, and states in most unequivocal terms his own ideas regarding what constitutes a proper physical examination. We should have enjoyed a thicker studding of the volume with this same style of writing.

THE new third edition of Edwards' *Practice of Medicine*[1] has been reviewed for us by Dr. Mandel in the following words:

"The book is practically rewritten and rearranged to conform with the more recent classification of diseases. Much new matter has been added. Especially commendable is the space devoted to diagnosis. The differential diagnostic tables, covering diseases of the heart, liver, kidneys, blood states, etc., are complete and practical and should be of value to the student and teacher. Surgical indications in border-line cases, statistics, medical and surgical, and the extensive bibliography enhance the value of this new work and create a special appeal to the surgeon.

"Treatment is outlined in great detail. This is particularly true in the treatment of cardiac insufficiency, syphilis, and tuberculosis. The dietetic treatment of nephritis and diabetes approaches in completeness that which we might expect in a work on dietetics. The discussion of the physiological action and therapeutic indications of the more commonly used drugs is another unique and laudable feature of the volume.

"In this edition, as in the two previous editions, the author has succeeded in subordinating the theoretical and eliminating the obsolete, thereby giving us a *Practice* which is complete, practical, and up-to-date, an ideal text-book for students, a necessity for the general practitioner, and a valuable addition to the library of the teacher."

[1] A TREATISE ON THE PRINCIPLES AND PRACTICE OF MEDICINE. By Arthur W. Edwards, A.M., M.D. Third edition. Philadelphia and New York: Lea and Febiger, 1916.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

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ADVISORY COMMITTEE OF CIVILIAN PHYSICIANS AND SURGEONS ON MEDICAL PREPAREDNESS

INFORMALLY, it was brought to the attention of a number of civilian physicians that a consulting committee on medical preparedness would be desirable. This resulted in a suggestion that the presidents of the American Medical Association, the American Surgical Association, the Congress of American Physicians and Surgeons, the Clinical Congress of Surgeons of North America, and the American College of Surgeons should jointly appoint an ad interim committee which could co-operate in developing the civilian and reserve medical resources of the country to the highest point of efficiency. As a result of these suggestions, the following committee was appointed in the manner indicated, the presidents of the various societies acting as members of the committee:

William J. Mayo, Chairman, Rochester, Minn.
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Frank Billings, Chicago
John F. Binnie, Kansas City, Mo.
Joseph C. Bloodgood, Baltimore
George E. Brewer, New York City
George W. Crile, Cleveland
J. M. T. Finney, Baltimore
Charles L. Gibson, New York City
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Fred B. Lund, Boston
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Franklin H. Martin, Chicago
Rudolph Matas, New Orleans
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Hubert A. Royster, Raleigh, N. C.
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Henry Sewall, Denver
Richard P. Strong, Cambridge, Mass.
William S. Thayer, Baltimore
Albert Vander Veer, Albany, N. Y.
Victor C. Vaughan, Ann Arbor, Mich.

This Committee met in Chicago for organization on April 14. Dr. William J. Mayo of Rochester, Minn., was elected Chairman of the Committee, Dr. Frank F. Simpson of Pittsburgh, Secretary, and an Executive Committee chosen as follows:

George E. Brewer	William J. Mayo
George W. Crile	Franklin H. Martin
J. M. T. Finney	Frank F. Simpson
Robert G. LeConte	William S. Thayer
Fred B. Lund	Albert Vander Veer

On April 20, the Executive Committee met in Washington and presented in person to President Wilson the following memorandum:

WASHINGTON, D. C., April 20, 1916.

Dear Mr. President:—We, the undersigned, acting as a committee on behalf of four national societies, to wit: the American Medical Association, the Congress of American Physicians and Surgeons, the Clinical Congress of Surgeons of North America, and the American College of Surgeons, representing an aggregate membership of 90,000 medical men, have the honor respectfully to present our greeting and to tender to the Federal Government our services toward the medical welfare of the Army and Navy, being impelled so to do by the following considerations:

1. In times of peace as well as in times of war, the medical profession, as above represented, holds itself in readiness, out of a spirit of patriotism and of co-operation, to serve the best interests of the Federal Government.

2. The European war, especially during its first six months, demonstrated a greater need, both of medical supplies and of more efficient organization of medical resources, in connection with military and naval activities than was formerly deemed necessary or adequate.

3. Every soldier and sailor in the service of the Federal Government is entitled at all times to protection in sanitary matters, and to proficient medical and surgical care.

Prompted, therefore, by these considerations, the medical profession, as above represented, respectfully offers its services toward the well-being of the army and navy departments. Among the services which at this time the above named organizations specifically tender their co-operation, in conjunction with existing facilities of the Army and Navy for such purposes, are:

1. To establish, through their respective membership and their affiliations with local medical societies of the states and territories, an or-

ganization that would be in a position to make a comprehensive survey of the medical resources of the country.

2. To make a complete invoice of such resources available in peace and in the emergency of war. This invoice would include not only the names of men available for field or home duty who are trained in the specialties of medicine, surgery, and sanitation, but it would also include the extensive equipment under the control of these men, such as hospital facilities and lists of trained nurses.

3. To aid in the public health service, in sanitation, quarantine, and hygiene of the troops; to aid in the inspection of camps and posts; to analyze water sources and supply systems; to study effects of climates, exposure, diet, etc., all designed for the welfare of the individuals enlisted in the Army and Navy Departments.

The medical profession, as above represented, respectfully submits that thorough organization of the civilian and reserve medical resources of the country are of primary importance in the proper preparedness of the country. It does not, however, here and now offer or imply any recommendation as to the national policy for preparedness beyond adequate sanitary, medical, and surgical protection of those who may be enlisted in the army and navy departments.

Respectfully submitted,

WILLIAM J. MAYO,
Chairman, Committee of American Physicians

ALBERT VANDER VEER,
President, American Medical Association

WILLIAM S. THAYER,
President, Congress of American Physicians and Surgeons

FRED B. LUND,
President, Clinical Congress of Surgeons of North America

J. M. T. FINNEY,
President, American College of Surgeons

FRANK F. SIMPSON,
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GEORGE W. CRILE
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HENRY SEWALL
RICHARD P. STRONG
VICTOR C. VAUGHAN
G. E. DESCHWEINITZ

The General Committee, in pursuance of its plan for a general survey of the medical resources of the country, has selected a committee in each state to aid in the work. These state committees are listed below. Members of the General Committee are also members of the state committees for the states in which they reside. To the General Committee have been added the following as members ex officio:

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Rupert Blue, Surgeon General, United States Public Health Service
Colonel Jefferson R. Kean
Major Robert E. Noble
President, American Medical Association
President, American Surgical Association
President, Congress of American Physicians and Surgeons
President, Clinical Congress of Surgeons of North America
President, American College of Surgeons,

with the following as Associate Members:

Winford Smith, M.D., Baltimore
Eugene Smith, Dean, Harvard Dental School
Edward C. Kirk, Dean, University of Pennsylvania, Dental Department
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